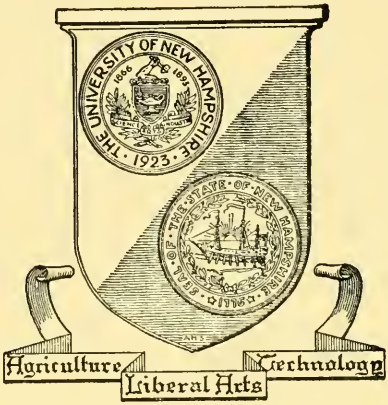
SHOUT
SHARE
IT

Library of



The University
of
New Hampshire

	Nitrogen		Phosphoric Acid				Potash		Magnesium Oxide	
			Total		Available					
	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found
Sewerage Commission Milwaukee, Wis.										
Milorganite	6.00	6.01	....	2.68	2.00	2.28	....	....	..	....
Swift & Co. Baltimore, Md.										
Vigoro	4.00	4.03	....	12.86	12.00	12.14	4.00	4.12	....	....
Welland Chemical Work, Ltd. Niagara Falls, Ontario										
Nitraprills (Ammonium Nitrate)	33.50	33.60	....	....	....	....	....	....	....	....

BULLETIN 372 SEPTEMBER, 1947

Agricultural Research in New Hampshire

Annual Report of the Director of the
Agricultural Experiment Station
For the Year Ending
June 30, 1947

AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF NEW HAMPSHIRE
DURHAM, N. H.

TABLE OF CONTENTS

Experiment Station Staff 6

Comments by the Director 7-11

Changes in Personnel 12

Publications 13

AGRICULTURAL CHEMISTRY

The Carbohydrates of Pasture and Hay Crops as Related to their Utilization by Cattle 15

Study of Thiamine Assay Methods 15

The Effects of Quick Freezing on the Vitamin Content of Strawberries, Red Raspberries, and Blueberries 15

The Effect of Freezing and Dehydration Upon the Carotene Content of Blue Hubbard Squash 16

The Effects of Canning and Quick Freezing on the Vitamin Content of String Beans 16

Chemical Studies on Methods for Determining Certain of the Vitamins as They Occur in Foods 16-18

AGRICULTURAL ECONOMICS

Seasonal Milk Pricing and Supplies 18-19

Milk Transportation at Colebrook 19-20

Developing Home and Market Outlets for New Hampshire Farm-Produced Foods 20-21

Chore Practices in Dairy Barns 21-22

CROPS

Rotation, Fertility, and Cultural Experiments with Potatoes in Northern New Hampshire 22-23

The Relative Efficiency of Plowing Down Fertilizers 23

The Production of Seed for Forage Crops 23-24

The Improvement of Ladino Clover, Red Clover, and Timothy by Selection and Breeding 24

Variety Trials of Oats and Barley 24-25

Experiments with Small Grains in Northern New Hampshire 25-26

Silage and Field Corn Trials 26

Introducing New Potato Varieties for Certified Seed 27

Proper Construction of Farm and Commercial Potato Storages 27

Drying Young Grass for Use as a Grain Substitute 27-28

DAIRYING

Relationship of the Composition of Milk to Methods Used for Determining Adulteration 28-29

Cobalt Treatment of a Nutritional Disease of New Hampshire Cattle, Sheep, and Goats 29

Supplemental Vitamin D for Dairy Cows 29
The Relation of Trace Minerals to Vitamin Synthesis in the Rumen of Dairy Animals 29-30
Studies on Bovine Mastitis 30

ENTOMOLOGY

Penetration and Toxicity of Contact Insecticides 30-31
Insect Record 31-32
Apple Maggot 32
Studies of Insects Affecting Spruces 32
Proposed Study of Spray and Dust Deposits 32-33

FORESTRY

Sugar Maple Propagation 33
Characteristics of Sap Flow 33-34
Reproduction Studies 34
White Pine Stands 34
Devices and Implements Useful in Farm Logging 34-35

FRUITS

Leaf Scorch in Deciduous Fruit Plantings 35
Body Stocks and Understocks for New Hampshire Apples 35
Blueberry Culture 36
Breeding Work and Varietal Tests 36
Cultural Practices 36-37

ORNAMENTALS

Chrysanthemum Variety Tests 37
Lilac Culture 37

PASTURES

Producing the Full Roughage Requirements on New Hampshire Dairy Farms with Special Reference to Pastures 37-38
The Use of Herbicides in New Hampshire with Particular Reference to Pastures 38-39
Pasture Management 39-40

PLANT PATHOLOGY

Factors Influencing the Development or Suppression of Leaf Roll Symptoms in Potato Foliage in the Greenhouse 40
The Control of Tomato Diseases 40-41
Plant Disease Investigations 41
Testing New Pesticides 41-42

POULTRY HUSBANDRY

Protein Requirements of Chickens at Various Stages of Growth and Development 42-43
A Study of the Cause and Prevention of Gizzard Lesions in Chickens 43
Choline in the Nutrition of Poultry 43-44
Utilization of Sulphite Yeast as a Feedstuff for Poultry 44-45

SOILS

Methods for Controlling Erosion on New Hampshire Potato Farms 45-46
The Influence of Soil Texture, Soil Moisture, and Soil Aeration on the Growth of Plants 46-47
A Survey of the Soils of New Hampshire 47

VEGETABLES

Squash Storage 47-48
Breeding Work 48
Varietal Tests 48-49
Cultural Practices 49

STATE SERVICE

Inspection of Fertilizers and Feedingstuffs and Soil Testing 49
Seed Inspection 49-50
Pullorum Testing Poultry Laboratory 50
Infectious Bronchitis Inoculations 50
Autopsies at Poultry Laboratory 50
The National Poultry Improvement Plan 50-51
Dairy Testing 51

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION STAFF
1947-48

ADMINISTRATION

M. Gale Eastman, Ph.D., Dean and Director
Harold C. Grinnell, Ph.D., Assistant to Dean and Director
Russell C. Smith, Purchasing Assistant
Walton E. Devine, Assistant Treasurer
Ella S. Bowles, Publications Editor
Thelma Brackett, A.B., Librarian
Wilfred T. Harwood, Libraray Assistant in Charge, Plant and Animal Sciences Library

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

Thomas G. Phillips, Ph.D., Chemist
Todd O. Smith, M.S., Associate Chemist
Stanley R. Shimer, M.S., Assistant Chemist
Gordon P. Percival, M.S., Assistant Chemist
Helen J. Purinton, Ph.D., Assistant Chemist
Arthur E. Teeri, Ph.D., Assistant Chemist
Henry A. Davis, M.S., Assistant Chemist
Margaret Loughlin, A.B., Assistant in Agricultural and Biological Chemistry

AGRICULTURAL ECONOMICS

Harry C. Woodworth, M.S., Agricultural Economist
Max F. Abell, Ph.D., Assistant Agricultural Economist
Harold C. Grinnell, Ph.D., Assistant Agricultural Economist
Lawrence A. Dougherty, B.S., Assistant Agricultural Economist
William Bredo, M.S., Assistant Agricultural Economist
John C. Holmes, A.B., Assistant in Research in Agricultural Economics

AGRICULTURAL ENGINEERING

George M. Foulkrod, M.S., Agricultural Engineer

AGRONOMY

Ford S. Prince, B.S., Agronomist
Leroy J. Higgins, B.S., Associate Agronomist
Paul T. Blood, M.S., Assistant Agronomist
Louis T. Kardos, Ph.D., Assistant Agronomist
Reeshon Feuer, B.S., Soil Survey Assistant
Bessie G. Sanborn, Seed Analyst
William H. Mitchell, B.S., Graduate Assistant in Agronomy

BACTERIOLOGY

Lawrence W. Slanetz, Ph.D., Bacteriologist
Fred E. Allen, D.V.M., Veterinarian
Ian M. Miller, B.S., Graduate Assistant in Bacteriology
Lillian M. Richards, B.S., Laboratory Technician in Bacteriology

BOTANY

Albion R. Hodgdon, Ph.D., Plant Taxonomist
Stuart Dunn, Ph.D., Plant Physiologist
Mathias C. Richards, Ph.D., Plant Pathologist

DAIRY HUSBANDRY

Kenneth S. Morrow, M.S., Dairy Husbandman
Ernest G. Ritzman, M.S., Research Professor Emeritus in Animal Husbandry
Harry A. Keener, Ph.D., Associate Dairy Husbandman
Herbert C. Moore, M.S., Associate Dairy Husbandman
Albert D. Littlehale, Herdsman

ENTOMOLOGY

James G. Conklin, Ph.D., Entomologist
Walter C. O'Kane, D.Sc., Entomologist
Robert L. Blickle, Ph.D., Assistant Entomologist
Wallace J. Morse, B.S., Research Chemical Assistant in Entomology

FORESTRY

Clark L. Stevens, Ph.D., Forester
Lewis C. Swain, M.F., Associate Forester

HORTICULTURE

Albert F. Yeager, Ph.D., Horticulturist
E. J. Rasmussen, M.S., Research Associate in Horticulture
L. Phelps Latimer, Ph.D., Assistant Horticulturist
William W. Smith, Ph.D., Assistant Horticulturist
C. Lyman Calahan, B.S., Horticultural Farm and Greenhouse Superintendent
James Macfarlane, Greenhouse Assistant
Pierce Beij, B.S., Graduate Assistant
Peter Moorenovich, B.S., Greenhouse Foreman

POULTRY

T. Burr Charles, M.S., Poultry Husbandman
Richard C. Ringrose, Ph.D., Assistant Poultry Husbandman
Fred E. Allen, D.V.M., Veterinarian
Alan C. Corbett, D.V.M., Pathologist
C. W. Hess, Ph.D., Geneticist
Edwin T. Bardwell, B.S., R.O.P. Supervisor
Richard S. Ford, Senior Laboratory Technician in Poultry Husbandry
Donald S. Cross, Senior Laboratory Technician in Poultry Husbandry
J. P. Ackerman, Laboratory Technician in Poultry Husbandry
Ruth E. Rinta, Assistant Laboratory Technician in Poultry Husbandry
Kathryn Moore, Assistant Laboratory Technician in Poultry Husbandry

ASSISTANTS TO THE STAFF

Maisie C. Burpee, Secretary
Theresa R. Batchelder, Mail Clerk
Martha E. Fisher, Senior Stenographer-Clerk
Kathrina H. Legg, Senior Stenographer-Clerk
Amber H. Hall, Senior Stenographer-Clerk
Sara M. Sanborn, Senior Stenographer-Clerk
Laverna E. Murphy, Senior Stenographer-Clerk
Edith M. Smith, Senior Stenographer-Clerk
Alma Tirrell, Senior Stenographer-Clerk
Adrienne Girard, Stenographer-Clerk
Claire E. Girard, Stenographer-Clerk
Dorothy Noyes, Stenographer-Clerk
Bernadine E. Davis, Stenographer-Clerk
Patricia H. Spalding, Stenographer-Clerk
Rita Baillargeon, Stenographer-Clerk
Elaine Tamburello, Stenographer-Clerk
Elizabeth Carey, Stenographer-Clerk

Comments by the Director

LET US CONSIDER for a moment the thinking of the world 150 years ago as evidenced by the Malthusian doctrine which was an example of current thought about the year 1800.

Thomas Robert Malthus was a minister and the son of a minister. From the nature of his calling and from what we know about his investigations of rural conditions in France, Scandinavia, Russia, and other countries we may gather that he had a profound interest in the welfare of his fellow men. He had noted the attempts of poor people to eke out existences on farms. Finally, he evolved a social doctrine to the effect that the human race tended to increase faster than it was possible to produce food from the land the people occupied, and that a large measure of the squalor, degradation, and suffering of humanity on the fringes of society was due, primarily and ultimately, to a lack of food. So long as population multiplied faster than it was possible to increase food products from the land — so long must people die of starvation.

Malthus even expressed his findings in mathematical form. For example, population tended to increase in geometrical ratio 2, 4, 8, 16, while, at best, food production tended to increase in arithmetical ration 2, 4, 6, 8. This must lead to ever greater discrepancies between the number of stomachs to be satisfied and the total production of the soil.

His finished conclusions were published about the beginning of the nineteenth century. At that time, the world's population, as nearly as we can determine, was 850,000,000. In perspective, the amazing thing is that while the ages and eons of time down to the year 1800 had accumulated only this number of people in the whole world, within the comparatively short time of a century, or by the year 1900, world population had more than doubled. What happened that people suddenly should increase so fast? Why did we add another world of people in a hundred years to that which we already had, regardless of the Malthusian doctrine? How did we feed them?

Among numerous developments of this century was a growing recognition of the potential capacity of the United States for agricultural production in a much larger way. Not only did the early settlers, who were largely confined to the Eastern Seaboard, begin to sense the potential possibilities of the Middle West when, and if, it could be more easily reached and better utilized but they also entertained aspirations and hopes that stimulated their budding ingenuity into activity. These sentiments became so general and persistent that The Congress found itself involved in seeking solution to some of the national problems involved.

Following several proposals and one or two abortive Congressional acts, our national law makers evolved the Homestead Act. It became law in 1862 and immediately proved an effective instrument in stimulating the occupation of vast reaches of the national domain stretching far toward the west. In this same year some profound thinking for national planning led by Senator Morrill of Vermont came to fruition in the Land-Grant College Act. Both these acts were effective and their far-reaching influence tended to revolutionize the world's thinking about food no less than to stimulate increased use of our own agricultural resources in America.

Twenty-five years later, harboring no small amount of discouragement from the lack of progress in the teaching of agriculture as a science in our newly-conceived colleges, further legislation was sought to make organized experimental work available in the quest for obviously needed agricultural facts. In 1887, the Hatch Act, which provided each state agricultural college with a nucleus of $15,000 a year to establish an agricultural experiment station, was passed by The Congress. This development immediately started an accumulation of scientific information. Crop yields from different practices and varieties were tabulated. The results of feeding different rations to different animals were considered and summarized to accumulate simple, but significant, data for teaching and for further research. For example, the first bulletin published by New Hampshire's Agricultural Experiment Station, in 1888, was entitled, "Ensilage." Bulletins 2, 3, and 4, published within the same year, were entitled, respectively, "Feeding Experiments", "When to Cut Corn for Ensilage", "The Science and Practice of Stock Feeding". The next year, we published "Fertilizer and Fertilizing Materials", "Experiments with Fertilizers", "Test on Dairy Apparatus", "Feeding Experiments - Part I - Principles of Feeding, Part II - Corn Meal, Middlings, Shorts and Cottonseed Compared".

It is reasonable to assume that these various and significant investigations of homely, everyday farm practices seemed a little too commonplace for the intelligentsia, who began to question their importance. The Congress was able to satisfy them, apparently (as well as more practical people who sensed the extreme value of just this kind of a beginning) by passing, in 1906, the Adams Act which added another annual stipend of $15,000 to each agricultural experiment station but specified that it must be used for *fundamental* research.

The next big world event which transpired was to harass humanity. It greatly influenced agricultural research; and its aftermath was peculiarly upsetting to agriculture as a whole. This was the First World War which ended in 1918. A few examples will suffice to show what wonderful progress American farmers had made up to that time. Previous to 1914, when this war began, we had reduced our farm population relatively to such an extent that scarcely one-fifth of our people now lived on farms. They represented not more than four per cent, or one-twenty-fifth of the world's farmers. But this little handful of agricultural producers was averaging year by year to produce 70 per cent of all the corn grown in the world, 60 per cent of the cotton, 50 per cent of the tobacco, 20 per cent of the oats and hay, 50 per cent of the hogs, and 25 per cent of the cattle. In an attempt to pay interest, at least, on our European indebtedness for money borrowed to develop our railroads, farm machinery, and other enterprises during recent decades of the country's westward expansion, we had come to export annually more agricultural produce to help foreign countries than all the rest of the world's farm exports added together. Everybody is aware of some of the significance of agricultural production in helping to win that war, notwithstanding the threats and accomplishments of German U-boats.

Again, following this war, appreciation of what agricultural production had done and the significance to date of agricultural research in making such production possible contributed to another most significant boost to experi-

mental work. By 1925, The Congress had passed the Purnell Act which was to give to agricultural experiment stations at the end of five years an additional $60,000 each, or twice as much as they had ever had up to this time. This Act broadened still more the concepts of agricultural research to include home economics, rural sociology, etc. Great strides were made in agricultural advancement and the results of research were so obvious again that no later than 1935 The Congress passed the Bankhead-Jones Act offering additional funds to the states. This new legislation differed from previous acts in two respects. First, it required "offset" funds from the state. Every dollar of Federal money must be matched with another dollar to be contributed by the state. And second, the amount allotted to each state was based on rural and farm populations, so the amount varied from state to state. Like the provisions of the Purnell Act the appropriations were to increase for a period of years. New Hampshire's Bankhead-Jones allotment from the Government finally amounts to a total of $9,216.35, to which the state has to add an equal amount.

Then came the Second World War. In turn, it was declared at an end in 1946. Once more we were made aware of the magnificent job which American farmers did in contributing to the final favorable outcome of a terrible carnage. Presumably, The Congress again was impressed with our country's leadership in agriculture and with the importance of the need for still more research in order to continue the maintenance of that leadership. On August 14, 1946, it passed the Flannagan-Hope Act, which is an amendment to the Bankhead-Jones Act and written in somewhat similar terms. It is written to increase station contributions over a period of five years, and then to continue indefinitely. The Congress adjourned without appropriatting the funds involved, but the Act presumes that money from Washington will be forthcoming, of which New Hampshire's share roughly might be something like $100,000. Practically all this money must be matched dollar for dollar with state money.

To recapitulate: after the First World War, Purnell funds added to our Station twice as much money as we had had previous to the war. To that was added the Bankhead-Jones funds to make our annual income in New Hampshire something over $100,000. This most recent Act, following the Second World War, would give another $100,000 from Washington if the state will also add $100,000 to go with it. If, and when, all these funds are appropriated, our Station income virtually will be tripled.

This is a lot of money. One's easy reaction might be "What will be done with all this additional income?

In answer to such a question, we need to realize that adding twice as much money as we had before World War II will not increase the potential output in the same ratio as the funds. Costs for everything have increased substantially. Day laborers' wages were doubled after the First World War and they have doubled again since the Second World War. Even in agricultural research much routine work must be accomplished by such labor.

The research work that we are attempting now is really getting down to fundamentals. It is a much more refined, intricate, detailed, searching research than in the early days. A great deal of this detail requires expensive equipment to accomplish a job efficiently. For example, the station's auto-

matic temperature recording machines keep records all night in an orchard and in specific places such as under the bark of a tree, in the ground, or on the side of the tree away from the sun. Our card-sorting machines (after data have been placed on pieces of cardboard, about the size of a postal card) sort cards in deference to any one heading and at the same time add these and other figures by columns. One of these machines has been in use at the New Hampshire Agricultural Station for several years. The second we have hired and used in Boston.

There are suggestions that the atomic bomb can be related to commercial enterprises. This Station has been experimenting with a phase of atomic bomb development as it relates to agriculture. For instance, it is a part of the bomb construction process to have so-called "activated elements". Phosphorus, which is a plant food, can be treated so that it is activated. We might apply this activated phosphorus to the ground and, later, with the aid of a Geiger-counter, determine whether or not that particular phosphorus has gone to the stems, leaves, or other parts of a growing plant.

We have a photo-electric spectrometer which can analyze solutions instead of making use of a long manual process of chemical analysis. With this instrument, it is possible to do in three seconds what with ordinary chemical methods would take a well-trained person three weeks to accomplish. Perhaps these examples will serve to make obvious the fact that experimental work cannot be carried on today without up-to-date equipment. Furthermore, we must realize that this equipment is not only very expensive but also has increased greatly in cost since the war.

What I am saying is that the American people did not refute the Malthusian doctrine by throwing the land in the mid-west into the production of human foods. That production in itself was significant; but it would have been but a drop in the bucket toward finally satisfying the stomachs of our present 2,000,000,000 people in the world, if we had not added to that remarkable progress in producing more and better crops per acre. We have also made progress in producing more of the crops best adapted for food for both domestic animals and for man. Even yet we have just scratched the surface in our investigations of these newer problems. For example, we have only recently heard about vitamins and their relation to human welfare. We still know too little about them. So long as a pound of butter may have anywhere from five units to five thousand units of a certain vitamin, there is no very scientific way of measuring how much butter a person should eat in order to get a suitable daily ration. Today, those of us who are studying feeds and feeding sciences for the best production among farm animals may not realize how very little is really known about the proteins required for adequate maintenance. It is not only quite possible, but also quite probable, that we feed entirely too much protein. There is also the question of substituting more, or all, of the cheaper vegetable proteins for animal proteins. The difference here, according to indications from recent research work, might conceivably be one of vitamins, which might be provided in other and more efficient and economical ways. It might be disconcerting to the Malthusian doctrine to contemplate the fact that a very high protein feed can be synthesized from wood-waste, (specifically sawdust piles). We have already fed such a protein product experimentally with good results at the

New Hampshire Agricultural Experiment Station. Synthetic foods of the future might even be divorced, if not entirely, at least partially, from land use.

Through experimental work with forage plants, we are certainly developing more prolific, weather- and disease-resistant and more nutritious natural feeds for farm animals. Similarly ,through scientific methods of breeding, we are obtaining in New Hampshire more palatable vegetables which are better adapted to local soils and climate. Because of this knowledge, vegetables are more easily grown, and in at least one instance, have three times as much vitamin content as the plants previously cultivated. In the New Hampshire climate, it is necessary to preserve fruits and vegetables for winter use. At the Station, we have carried on extensive experimental work in methods of preservation. This work is just about to give us some very important information. With the new processes of preservation in operation (such as deep-freeze units) this knowledge doubtless will tend to help increase the health and longevity of New Hampshire people.

The cause of a deficiency disease of ruminants, which has engendered widespread and inestimable losses in New Hampshire since colonial times, has now been identified and a practical cure worked out. The consistent loss of appetite with consequent stunting of growth, wasting away, and frequent death of some of the animals investigated have been traced to a lack of cobalt — even the very small amount required — in our New Hampshire soils. The trouble is easily corrected in the feed given ruminants at an almost negligible cost.

If you have followed my argument that America has taken the lead in trying to refute the Malthusian doctrine that the human population of this world cannot be fed, and has set the pace in methods of production and efficiency of production to continually replenish the world's larder, let me add to it by reminding you that no country under the sun has ever produced half as much per person engaged in farming as have the farmers in America. Machinery, ingenuity, and research have made this possible.

Finally, we need to disillusion our minds of the idea that all progress in this respect has been accomplished. My prophecy at the moment is that we stand tiptoe on the threshhold of phenomenal improvements in agriculture through research; better production of crops, better fertilization, better use of soils, better feeding of domestic animals and, particularly, better nutrition for the human race; the kind of nutrition that will contribute unmistakably to good health and longevity.

No deadline in research is evident any more than is an end to human wants.

M. G. E.

CHANGES IN PERSONNEL

Additions to Staff

Ackerman, J. P., Laboratory Technician in Poultry Husbandry, October 1, 1946

Baillargeon, Rita, Stenographer-Clerk in Agronomy, July 26, 1946

Beij, P. H., Graduate Assistant in Horticulture, September 16, 1946

Bredo, William, Assistant Agricultural Economist in Agricultural Economics, August 1, 1946

Calahan, C. L., Superintendent of Horticulture Farm and Greenhouse, formerly graduate assistant in Horticulture

Devine, W. E., Assistant Treasurer at Business Office

Dudley, R. P., Assistant in Research, Bacteriology, February 10, 1947

Feuer, Reeshon, Soil Survey Assistant in Agronomy, February 1, 1947

Field, C. H., Poultry Inspector, December 9, 1946

Fitton, H. F., Assistant Treasurer, Business Office, September 1, 1946

Foster, J. R., Poultry Farm Assistant, February 19, 1947

Glidden, Lauris, Assistant at Poultry Plant, April 14, 1947

Moore, Kathryn (Mrs.), Assistant Laboratory Technician in Poultry Husbandry, October 1, 1946

Moorenovich, Peter, Acting Greenhouse Superintendent, February 1, 1947

Rasmussen, E. J., Research Associate in Horticulture, January 7, 1947

Richards, Lillian, Laboratory Technician in Bacteriology, July 1, 1946

Tamburello, Elaine (Mrs.), Stenographer-Clerk in Horticulture, October 1, 1946

Tirrell, Alma (Mrs.), Stenographer-Clerk, September 26, 1946

Losses from Staff

Chagnon, Gloria, Stenographer in Agricultural Economics, May 15, 1947

Clapp, Henry S., Assistant Horticulturist, June 30, 1947

Connor, Barbara, Assistant in Research, Home Economics, September 30, 1946

Ferry, Rosamond, Senior Stenographer-Clerk in Horticulture, October 1, 1946

Field, Charles H., Poultry Inspector, June 30, 1947

Fitton, H. F., Assistant Treasurer, Business Office, June 21, 1947

French, Jean, Laboratory Technician in Poultry Husbandry, June 30, 1947

Fullington, Mildred, Stenographer-Clerk in Horticulture, August 14, 1946

Hopp, Richard, Graduate Assistant in Horticulture, May 31, 1947

Kalin, E. W., Superintendent of Greenhouses, February 28, 1947

Miller, Margaret (Mrs.), Stenographer in Agronomy, July 24, 1946

PUBLICATIONS

Bulletins

364 Inspection of Commercial Feedingstuffs

365 Results of Seed Tests for 1946

366 Inspection of Commercial Fertilizers

367 Agricultural Research in New Hampshire

368 Performance of Strawberry Varieties in New Hampshire

Circulars

72 Efficient Dairy Chore Practices

73 Chore Practices on New Hampshire Commercial Poultry Farms

74 The Response of Clover and Total Forage to Top-Dressing Fertilizer

Technical Bulletins

91 The Movement of Phosphorus in Red Maple and Apple Trees in Winter Using Radioactive Phosphorus as a Tracer

Scientific Contributions

103 How to Grow the Gardenia

104 The Soils of New Hampshire as Related to a Deficiency in Cattle Responding to Cobalt

105 Changes in the Composition of Squash During Storage

106 Studies of the Chemical Composition of Calf Blood

107 Lycopersicon Peruvianum as a Parent in the Development of High Ascorbic Acid Tomato Varieties

108 Choline in the Nutrition of Laying Hens

109 Response of the Lowbush Blueberry to Fertilizers

110 Retardation of Sprouting of Potatoes by Carbon Dioxide Storage

Expenditures for the Fiscal Year Ending June 30, 1947

	Hatch	Adams	Purnell	B-Jones	Supplementary
Personal Service	$11,503.50	$13,757.86	$52,934.79	$7,380.38	$20,422.00
Travel	674.08	168.94	1,011.68	534.48	639.76
Transportation of Things	311.93	14.74	208.14	34.98	26.84
Communication Service	229.88	10.17	29.83	13.67	426.09
Rents and Utility Services	700.00		204.07	148.66	
Printing and Binding	219.99		200.72	3.45	791.25
Other Contractual Services	35.12	417.06	181.37	42.78	73.07
Supplies and Materials	803.17	398.82	2,227.65	766.17	1,605.14
Equipment	522.33	232.41	2,814.33	116.36	444.11
Lands and Structures (Contractual)			187.42	175.42	
	$15,000.00	$15,000.00	$60,000.00	$9,216.35	$24,428.26

Income for Supplemental Expenditures:

State Money for Bankhead-Jones Offset	$9,216.35
State Money for Station	6,084.21
Federal Sales	9,127.70
	$24,428.26

AGRICULTURAL CHEMISTRY

The Carbohydrates of Pasture and Hay Crops As Related to Their Utilization by Cattle

Lignin appears to be a controlling factor in the digestibility of energy according to an analysis of 25 samples of grasses and hays. A statistical study of the relation of composition to the digestibility of protein and energy is in progress.

T. G. Phillips

Study of Thiamine Assay Methods

Investigation of the possibilities of increasing the specificity of thiamine assays, by use of a colorimetric reaction involving the thiazole portion of this vitamin, has been carried out by making a study of chemical reactions which theoretically might be applicable to the quantitative determination of thiazole. It was found that thiamine, under certain conditions, produces a measurable colored compound with the cyanogen bromide reagent ordinarily used for the assay of nicotinic acid. This fact offers the possibility of a quantitative colorimetric assay procedure for thiamine involving cyanogen bromide. It also suggests the possible interference by thiamine in the assay nicotinic acid, particularly if such assay be carried out at steam-bath temperature and in the presence of a high concentration of thiamine.

A. E. Teeri

The Effects of Quick Freezing on the Vitamin Content of Strawberries, Red Raspberries and Blueberries

During the past year, data collected for this and previous years' studies with berries have been compiled. The work on this series of investigations will be included in one publication which is now in progress.

The 1946 work was conducted with strawberries in order to determine whether or not data obtained on berries frozen with sugar could be duplicated. All previous work indicated abnormally high values for ascorbic acid under this condition. Catskill berries picked at the height of the season (July 1) were procured from the same commercial grower as in the previous years. Following the established plan, a field sample was taken not more than two hours after picking. Samplings were made again after washing and hulling, preparatory to preservation. The berries were packed plain (whole) and with definite volumes of sugar syrup. These were analyzed immediately after quick-freezing and after five and eight months of storage.

The fresh berries contained 46 *mg.* of ascorbic acid per 100 grams and had a moisture content of 91 per cent. This compares very favorably with the fresh berries picked at the height of the season in 1944 and 1945. Plain frozen berries retained 39 *mg.* after an eight-month storage period. while those frozen with syrup showed an erroneously high figure of 50 *mg.* per 100 grams in the same period. This high figure duplicates similar data in previous studies.

S. R. Shimer, H. J. Purinton

The Effect of Freezing and Dehydration Upon The Carotene Content of Blue Hubbard Squash

The data obtained from studies on Blue Hubbard and Butternut squash in 1943, 1944, and 1945 have been compiled. This material will be cited in a publication which is now in manuscript form.

There was practically no difference in carotene content between squash held in cold storage for six months and squash frozen two weeks after harvest and stored a comparable length of time. In either case, stored squash provides an excellent source of carotene.

S. R. SHIMER, H. J. PURINTON

The Effect of Canning and Quick Freezing on the Vitamin Content of String Beans

Studies (similar to those of last year) concerning the effect of size (maturity) and season upon the carotene content of yellow string beans were conducted. One variety of snapbeans (Pencil Pod Black Wax) was grown in order to compare its carotene value with varieties (Bountiful and Asgrow) used previously. Two plantings of this variety were made one month apart. The beans from each planting were analyzed early and late in their growing season. They always were sized for maturity by the use of a bean gauge.

The carotene value of the fresh beans ranged from 0.2 *mg.* to 0.5 *mg.* per 100 grams; it was found to decrease after the beans reached a certain maturity, size #3.

The late pickings from both plantings had more carotene than the early pickings, ranging from 0.26 to 0.54 *mg.* per 100 grams of fresh beans for the first planting and 0.23 to 0.47 *mg.* per 100 grams of fresh beans for the second.

S. R. SHIMER, H. J. PURINTON

Chemical Studies on Methods for Determining Certain of the Vitamins as They Occur in Foods

Supplement No. 1, The Determination of Ascorbic Acid in Certain Foods.

During the course of previous studies upon the ascorbic acid content of strawberries, it was noted that sugar may be an "interfering" substance, insofar as the determination of ascorbic acid is concerned. At that time it was noted that berries frozen in the presence of sugar (or syrup) gave erroneously high ascorbic acid values, as measured by reaction of a buffered fruit extract with the dye. Since these erroneous values also had been encountered in previous years, it was deemed advisable to determine to what extent added sugar might influence the calculation of the retention of ascorbic acid in the berries during frozen storage.

As a source of naturally occurring ascorbic acid, berries of the Catskill variety, obtained at the height of the growing season, were again chosen for this year's work for comparison with previous results. The fresh berries contained 46 *mg.* ascorbic acid per 100 *gms.* (*cf.* 1943, 64-78 *mg.*, 1944, 49 *mg.*; 1945, 48-61 *mg.*) and 91 per cent moisture (*cf.* 1943, 89 per cent; 1944, 91 per cent; 1945, 90.6 per cent).

Analyses were made after washing and hulling the berries (one sampling, thoroughly mixed); again after 12 hours of quick freezing, of equal weights of berries packed plain and packed with syrup. In order to know the actual quantities of sugars present in the fresh berries, analyses were conducted for total sugars, fructose, glucose, and non-fermentable carbohydrates. These samplings were made on the fresh berries and after five and eight months storage of the preserved berries. Ascorbic acid determinations were run at the same storage periods.

The syrup used in the preservation of the berries was also subjected to the ascorbic acid determination in an attempt to obtain a figure comparable to a blank for the ascorbic acid evaluation.

In an attempt to determine to what extent various sugars react with the dye, pure sugar solutions were run through the routine method for ascorbic acid determination. The amount of reaction with the dye varied with the concentration of sugar.

Since extraction of ascorbic acid is carried out by means of a strong acid (metaphosphoric), it is obvious that the sugars present in the berries (or the added syrup) might be hydrolyzed. In order to determine whether or not the action of metaphosphoric acid on these sugars is a specific one, sugar solutions prepared in phthalate buffer (no HPO_3 used) were reacted with the dye. These gave readings at pH 3.6 which is commonly agreed upon as the best point for reaction of ascorbic acid with the dye. However, the use of metaphosphoric acid, prior to buffering and reacting with the dye, did give slightly higher values than were obtained with the phthalate buffer alone. This additional action could have been due to more complete hydrolysis.

If hydrolysis occurs during preparation of tissue for determination, or during frozen storage, glucose and fructose would be present to a greater extent than sucrose, at the time of the determination. Pure solutions of both glucose and fructose gave higher ascorbic acid values than did sucrose. It became obvious that some quantitative information regarding the distribution of various sugars, at the different storage periods, would be necessary before actual ascorbic acid values, due to berries alone, could be determined. After five months' storage, the sucrose concentration of the berries frozen with syrup was greatly decreased from values for fresh berries, while both glucose and fructose were increased — hydrolysis had occurred. Therefore, the ascorbic acid values obtained, which showed more ascorbic acid in the boxes of stored berries than had ever been placed in the box, were erroneously high because of the specific sugars present which were capable of reacting with the dye, used in the customary manner as evaluation of ascorbic acid concentration. Some quantitative relations between the concentration of sugars and "apparent" ascorbic acid values seem to be indicated. but even by applying these corrections it is not possible to account for *all* the discrepancies noted in the ascorbic acid figures for sugared berries. The possibility exists that other naturally occurring substances might be capable of reacting with the dye. Because it was noted in the literature that tartaric acid seems to exert a protective action on ascorbic acid in preserved strawberries, a series of studies upon the reactions of certain dicarboxylic acids (naturally occurring and produced in tissue metabolism) was undertaken. The natural

food constituents, tested in amounts which would be found in normal plant tissues, which were capable of giving "ascorbic acid values" were malic, tartaric, fumaric, and succinic acids (the last two, only slight activity). Oxalic and citric acids do not react with the dye. These are often used as tissue extractants for ascorbic acid.

Further studies are needed in order to obtain quantitative data on the sugars in fresh and preserved foods and to obtain "ascorbic acid equivalents" of these substances. The nature, as well as the degree of reaction, of these naturally occurring interfering substances will have to be ascertained before *actual* ascorbic acid values can be known, especially for foods with high sugar content.

Supplement No. 2, The Determination of Carotene in Certain Foods.

In previous studies, it was noted that yellow wax beans contained some carotene, although most literature records this food as lacking in carotene. According to the purpose of this project (*i.e.*, to investigate the various existing methods for determining carotene in foods), it was thought that studies of this variety of bean might show up differences in chemical methods. For this year's work, two plantings of Pencil Pod Wax beans were made. In order to study the distribution of carotene, if it were found present, some of the whole young plants were analyzed just prior to blossoming (34 days after planting) from each row and again after the plants were through bearing. Following the carotene determination of the plant, the whole beans were sized and similarly analyzed at various stages of development.

In using the Zscheile carotene method, saponification of tissue prior to extraction was compared to non-saponification. From the results so obtained, it seems that whereas saponification appears to aid in the extraction of carotene from the bean *plants*, it is not necessary for the purpose of extracting carotene from the *beans*.

Carotene was found to an appreciable extent in the small beans. Although still present in the more mature beans, the concentration of carotene decreased with age. The fresh beans averaged from 0.2 *mg.* to 0.5 *mg.* beta carotene per 100 *gms.*, as determined with the colorimeter (green peas, last year, 0.08 *mg.* to 0.3 *mg.* per 100 *gms.*).

H. J. PURINTON

AGRICULTURAL ECONOMICS

Seasonal Milk Pricing and Supplies

During the war years, consumption of fluid milk increased more rapidly than the supply in the metropolitan Boston market as well as in most of the milk markets in the United States. At the same time, the seasonality in milk deliveries became wider. As a result, during three of the last four years, producers in the Boston milkshed failed to deliver enough milk to meet requirements in the short months of November, December, and January. The high cost of bringing in milk from the Midwest encouraged the addition of several plants formerly in the New York milkshed. To prevent an overexpansion of the Boston milkshed, it is important to develop a price plan that will encourage the production of a larger proportion of milk in the fall months of short supply.

This study of seasonal pricing and supplies was initiated a few months ago as part of the interregional program in dairy marketing organized within the last year by the North Central and Northeastern agricultural experiment stations. The object of the present study is to determine the reasons for the degree and type of seasonal variation found in deliveries in individual plants, and to relate them to the seasonal price plans in use and to the motivation of a dairyman's seasonal production pattern.

Monthly data have been collected for a number of plants in the Connecticut and Merrimack Valleys. Computation and analysis are now in progress. For illustrative purposes some preliminary results from the analysis of a plant may be interesting.

Net seasonal movement; June as a percentage of November: (trend removed)

Year	1930	1932	1937	1940	1946
Blended price	96	114	92	81	93
Average daily volume per producer	97	105	118	125	139

Almost without interruption, from one year to the next, seasonality of average daily deliveries per producer increased. This is shown in the accompanying table by the rising percentage of June deliveries over those of November. In the first year of the depression, deliveries at this plant were contrary to the normal seasonal movement. The seasonal movement of blended prices was irregular during the period. The figures in the table show the extremes in seasonality. The fact that November prices were lower than June prices in the early 1930s may have been an important factor in reversing the seasonal variation of deliveries and of increasing it in the latter part of the decade. The reduction in the seasonal spread of blended prices in wartime, after correction for subsidy, apparently tended to increase the seasonal variation of the volume of individual dairymen.

W. BREDO, J. C. HOLMES

Milk Transportation at Colebrook

In July, 1946, information was obtained in the Colebrook milkshed concerning the operation of the Colebrook plan of milk transportation which had been developed four years earlier and had been administered by the O.D.T. It was found that several factors had changed the operation of the plan. Greater seasonal variation in the amount of milk had resulted in a large volume of milk in June; as a result, additional trucks were necessary for short periods to supplement several routes. The milkshed area also was expanded, requiring additional routes totaling 95 miles. In the five years, there was an astounding number of changes in producers and their locations. For example, of the 308 producers who shipped milk on April 30, 1942, only 175, or 57 per cent of the original number, were in the market on June 15, 1946. The total number of producers located in the original milkshed had fallen to 272.

The O.D.T. administration was highly successful in reducing the daily mileage on the main routes, but at no time was it possible to achieve the full reduction indicated in the original plan. Soon after the restrictions on the

use of trucks and gasoline were terminated, a portion of the efficiency which had been developed and maintained during the war was lost because a number of near-by producers insisted upon hauling their own milk. The efficiency gained by the reorganization of the longer routes was maintained. It is believed that reorganization of these long routes, in 1942, is responsible for their continued operation without an increase in rates. In the face of rising costs of labor and supplies, the truckers have rendered service without additional charges per hundred pounds of milk.

The tendency to modify the reorganized structure of milk assembly came almost wholly as a result of the entrance of a large number of self-haulers. This indicated that the reorganized trucking plan was not stable. The study indicates that for a trucking system to be stable each producer or hauler who is a part of it must be made to feel as well off as before reorganization. Since each indivdual must be at least as well off, some individuals must always be better off. Therefore, it is a justification for reorganizing a system. Moreover, for the system to remain stable, each indivdual must always feel at least as well off by staying within the system as he would by leaving it.

H. C. WOODWORTH, J. C. HOLMES

Developing Home and Market Outlets for N. H. Farm-Produced Foods

Additional surveys have been to learn more concerning the activities of locker and home freezer box owners. Meats make up the bulk of the product being stored in locker plants. In the largest plant, beef constituted more than one-half of all the products. Fruits and vegetables made up about 5 per cent of the total. Home box owners used relatively more space for fruits and vegetables. The convenience in freezing small amounts from the garden is an important factor here.

Greater savings accrue to those who grow a major portion of the products frozen. About half the locker holders and about three-fourths of the home box owners produced their own beef. About 75 per cent of both groups produced their own pork. About half of those who froze raspberries grew their own fruit, and almost 60 per cent grew their own strawberries. Choice of foods for freezing, in 1947, was expressed by a number of holders of freezer space, as follows:

Choice	Meats	Fruits	Vegetables
First	Beef	Strawberries	Peas
Second	Pork	Raspberries	Sweet corn
Third	Poultry	Peaches	Snap beans
Fourth	Lamb	Blueberries	Broccoli
Fifth	Veal	Blackberries	Greens

The average size of 45 home boxes was about 24 cubic feet, or five cubic feet per person. However, half of the owners want larger boxes.

Reports from about 100 locker holders and home freezer box owners showed use of space, in 1946, as follows:

	Approx. No. persons served	Space per family	Meat (lbs.)	Poultry (lbs.)	Fruits (lbs.)	Vegetables (lbs.)
Locker holders	4	13.1 cu. ft.	332	34	39	36
Home box owners	5	24.1 cu. ft.	440	89	77	134

Several turkey growers with small freezer plants stored and sold frozen turkeys to customers. The advantages were better utilization of labor, ability to dress when birds were ready, and better service to customers by giving them what they wanted on short notice.

Two plants successfully froze apples for sale in 1946. Ability to utilize off-color apples is important. A machine for peeling and coring is necessary to reduce costs. Demand for frozen apples for bakeries is assured but some of consumer demand was due to sugar shortage. While consumers like the convenience of frozen apples, part of the 1946 demand was due to the sugar in the pack. A future market exists and sales hinge on prices and consumer buying power. Other opportunities exist for sweet corn and squash as both can be grown well here, and nearness to large markets is an important factor.

Savings through freezing are indicated by both home freezer box owners and locker holders. Almost two-thirds of the locker holders and 80 per cent of the home box owners believed they saved money through the use of freezer space.

L. A. DOUGHERTY

Chore Practices in Dairy Barns

In the previous year, the leaders of this project had developed time and sequence patterns for combinations of 1-man and 2-single units, 1-man and 1 double unit, 2-men and 3-single units, and several other combinations for milking cows. These suggested time and sequence patterns were based on detailed stop-watch records of actual milking on over 100 farms, but the patterns were made up synthetically.

During the year, the patterns were checked by observations in the field. Some men who had adopted rapid milking procedure and had made considerable progress in faster milking were not able to follow the time pattern because they had too many abnormal milkers, or were afraid to change their present practices. However, other operators, who were also using the rapid milking procedure, were able to approach the time pattern in regularity, sequence, and timing.

The time and sequence pattern for the combination of 1-man and 2-single units indicated that 18 cows could be milked by one man in 37.8 minutes. The actual time on one farm where the operator studied the pattern and endeavored to follow it was 39.4 man minutes for 18 cows. The sequence and timing were exceedingly regular. This man worked at a normal pace, but because of the excellent timing the total task was done quickly and easily.

There were fewer instances of 1-man and 1-double unit combinations to observe. But one operator was found who approached the synthetic pattern closely. He prepared the cows too far in advance but milked quickly and followed a definite sequence. The time and sequence pattern for this combination indicated that one man could milk 18 cows and take care of the milk in 39.6 minutes. The actual time was 37.5 man minutes.

The combinations involving two men have been difficult to check with the pattern. Several records were made of 2-men and 3-single unit combinations but in each case the sequence and timing were poor. Unless the two men work well as a team, the cows are prepared too far in advance or individual cows are milked too long. In one case, the combination of 2-men and 2-double units was observed. The cows were prepared too far in advance and the hand stripping was delayed too long. In several instances about 20 minutes had elapsed between preparation of the cows and the completion of stripping.

The timing, analysis, and charting of milking detail this year indicate that most farmers can improve their milking practices.

H. C. WOODWORTH, J. C. HOLMES, K. S. MORROW

CROPS

Rotation, Fertility, and Cultural Experiments with Potatoes in Northern New Hampshire

This experiment is designed to test the nutrient needs of potatoes for minor elements on New Hampshire soils and to discover the relationships of the various plant food nutrients to quality as measured by specific gravity. Particular attention is devoted to the chloride-sulphate relationships in the greenhouse at Durham and in the field at Northwood Ridge and at Colebrook.

At Colebrook, on Coffin Field No. 2, potatoes are being grown in a two-year rotation with lime, manure, calcium sulphate, boron, and magnesium as variables, and which includes plots in which potassium sulphate is substituted for the chloride. Two cover crops, oats and crimson clover, are being grown in alternate years in the two-year rotation, with one series of plots under continuous culture. The effect of cover crops will not be evident until the 1947 crop is harvested.

The five-pound application of borax treatment gave the highest yield of any series, higher than the 20-pound level of borax, indicating that potatoes on this soil need small amounts of borax but not as much as 20 pounds per acre in a band application.

No explanation is apparent for the depressing effect of lime on potato yields, but a decline in yield because of the omission of magnesium was anticipated. This study is being continued.

Studies at Colebrook, in 1946, included tests on the sulphate-chloride relationship of potatoes of the Green Mountain and Katahdin varieties. The lower yield of Katahdin in comparison with Green Mountain was caused by poor stands.

It is apparent, from a study of the average quality rating of Green Mountains, that the substitution of potassium sulphate for the chloride raises the

starch content, thus affecting the specific gravity, whereas the Katahdin variety did not respond to potassium sulphate in the same manner. It is also interesting to note that potatoes with the highest specific gravity, hence the highest starch content, both in the Green Mountain and Katahdin varieties, were those on which no fertilizer was applied. Even here the Green Mountain variety showed more variation than the Katahdin.

These data are supported by work at Northwood Ridge, where the Katahdin variety was grown under a variety of treatments with complete fertilizers also without potash and without phosphorus in certain series. The omission of potash reduced the yield much more than the omission of phosphorus. Again, the Katahdin variety failed to respond to variations in sulphur and chlorine applications.

F. S. PRINCE, P. T. BLOOD

The Relative Efficiency of Plowing Down Fertilizers

This project is conducted on a Paxton soil in the corn processing area near Pittsfield. Four methods of applying fertilizer for the sweet corn crop are under study: (1) all of the fertilizer placed on the plow sole; (2) half placed on the plow sole and half applied with the planter; (3) half applied with the planter and half side-dressed at the time of the second cultivation; and (4) all of the fertilizer applied with the planter.

The two-year average yield for each treatment follows:

Treatment	Tons of green corn per acre
(1) All on plow sole	5.606
(2) Half on plow sole, half with planter	5.677
(3) Half with planter, half side-dressed	5.794
(4) All with planter	5.276

Results to date indicate that a somewhat larger yield is obtained by plowing under part or all of the fertilizer, or by delaying part of the application until mid-season rather than applying all of it with the planter at planting time.

F. S. PRINCE, P. T. BLOOD

The Production of Seed for Forage Crops

Severe winterkilling, due to ice cover in the early months of 1946, destroyed perennial red clover seedings to the extent that no seed was harvested during the season. In sipte of the nearly nine inches of rainfall in August, a one-acre plot of a late timothy strain was combined. Although about half of the seed from each head had shattered due to beating rains, a yield of 75 pounds of seed per acre was obtained.

A quantity of two strains of smooth brome was harvested by hand on August 6. This was later threshed with a head thresher and cleaned with a fanning mill. No attempt was made to determine acre yields, although the two strains varied greatly in number of seed stalks and amount of seed produced.

Another small lot of smooth brome was harvested on September 12. This lot proved to have a much lower percentage of germination, 25 per cent as compared with 90 per cent for that harvested on August 6. Whether late harvested brome seed would always behave in this manner or whether it was caused by heavy August rainfall, is undetermined.

P. T. BLOOD, L. J. HIGGINS

The Improvement of Ladino Clover, Red Clover, And Timothy by Selection and Breeding

Ladino Clover

Nine parent plants have been chosen as a result of several years' crossing and testing. The selection was made on the basis of combining ability as well as ability to compete with heavy grass seedings. These plants are being propagated clonally in the greenhouse, and additional crosses are to be made. During the season, clones of Ladino from several co-operating stations as well as seedlings from our own breeding program were grown. The superior ones have been brought into the greenhouse for propagation and breeding.

Red Clover

Descendants of 12 original families of red clover which showed a perennial tendency are still being eliminated because of disease susceptibility or other undesirable characteristics. The more desirable ones are being intercrossed in the greenhouse for further propagation and testing. Farm tests of the seed harvest in 1945 are under way. Although no seed of the original strain was harvested in 1946, there is still seed on hand from the 1945 crop which will be used for testing by farmers or other co-operating agencies.

Timothy

After two unsuccessful attempts to test the original parents of two timothy strains, due to causes beyond control, a third attempt may be successful. The purpose of this testing is to eliminate other inferior parents of the two strains of timothy which are now under test. Additional material from Ohio and other sources is being tested for comparison with local timothy families.

F. S. PRINCE, L. J. HIGGINS, P. T. BLOOD

Variety Trials of Oats and Barley

Oats

Twenty-seven varieties and strains of oats were planted May 3, 1946, at the Bunker Farm plots. The seed oats were furnished by the United States Department of Agriculture, co-operator in setting up uniform oat nursery trials in the New England States and New York. The standard "checks" were Erban, Vanguard, and Victory. Erban and Vanguard were only resistant to the stem rust disease and Victory was non-resistant to disease.

During the week of August 4, the oats were cut by hand according to order of ripening. Each row was weighed immediately to get the forage

yield; then the grain was threshed out by a "header". The grain was then bagged, dried, and cleaned in the laboratory by a new mechanical cleaner.

The 1946 oat yields were about the highest since the trials were started in 1943. There was some disease present, and Victory, which is not disease-resistant, was at the bottom on grain yield per acre. For the first time, Helminthosporium Blight attacked the varieties of Victoria parentage, namely, Vicland, Boone, Forric and C. I. 4301. Once again the Bond crosses, Clinton, Benton, Bondu, Eaton, and Mohawk, gave excellent results.

The forage weights and yields do not measure strictly uniform dry weights, and there were some differences in maturity. They indicate, however, relative yields for forage. This is significant because forage oats are important in New Hampshire.

L. J. HIGGINS

Barley

Six of the fifteen original barley varieties were grown in three replications along with the oat trials. As the two-row Alpha, Wisconsin Barbless No. 38 and Velvet have been grown in New Hampshire for many years, they were used as standard checks. Once again Alpha gave good yields and Wisconsin Barbless the least. The sensitivity of barley to soil conditions and susceptibility to disease makes barley returns somewhat questionable. Every row showed considerable disease during the growing season of 1946.

L. J. HIGGINS

Experiments with Small Grains in Northern New Hampshire

Fifteen varieties of oats and two of barley were grown on the Coffin Field near Colebrook, in 1945. This was the sixth year of these trials. During this period, some oat and barley varieties have been eliminated because of weak straw, low yield, or for other reasons, and others have been added as new promising varieties appeared.

Tests have been conducted near Colebrook at an elevation about 1,700 feet. At this elevation, crown rust and stem rust do not appear to be serious menaces to oat production, with the result that two of the older varieties, Upright and New Victory, have given higher yields than some of the new strains like Vicland or Clinton that have been bred for disease resistance. Moreover, the new disease-resistant oats are shorter, softer strawed, and do not stand up as well or make as much forage. The only reason, then, for Northern New Hampshire farmers to produce Vicland or Clinton is for seed purposes, for sale to farmers father south where oat diseases are a serious factor.

Of the new strains tried, Cornell 484a and D69x Bond, have proved outstanding. The Canadian varieties (all tall strawed sorts) Erban, Vanguard, Ajax, and Erban-Vanguard cross have done well. New Victory and Upright (both old, non-disease-resistant, tall strawed varieties) have been the best yielders. New Victory, however, exhibited 30 per cent smut, and is the only variety in which smut has appeared in quantity during any year.

Barley varieties have given disappointing yields in these tests. Barley is sensitive to soil deficiencies. Therefore, since these tests have been conducted on potato land, lime and other soil amendments favorable to barley have not been applied.

It is now planned to move these trials to a lower elevation, perhaps to the river valley, to see whether or not the varieties follow the same disease behavior pattern they have followed on the uplands.

P. T. BLOOD

Silage and Field Corn Trials

Silage Corn

Thirty-two varieties and hybrids were planted May 17, 1946, at the Bunker Farm plots. Nineteen seed sorts were replicated three times in eighteen hill rows with each hill thinned to three plants. Because seed was scarce, three seed sorts had only two replications and ten seed sorts had only one row of eighteen hills. As was the case in 1945, West Branch Sweepstakes, a high-yielding, open-pollinated variety, and Cornell 29-3, an excellent double-cross hybrid, were used as "standard checks."

The corn silage was harvested on September 11, 1946. Twelve hills of each replication were weighed for the calculation of the acre green weight yield. One hill of three plants of each replication was bagged and dried to obtain, on a uniform basis, the calculations of the yield of dry matter per acre.

In this eleventh year of the trials, both West Branch Sweepstakes and Cornell 29-3 gave excellent yields. Ohio M-15 also continued promising. One poor replication due to poor soil conditions cut the average yields of Ohio K-24, Ohio 4059, and Massachusetts Hybrid 62. The new dent-sweet hybrids developed at the Connecticut Agricultural Experiment Station showed considerable promise.

Grain Corn

Thirty varieties and hybrids in three replications of each were planted May 17, 1946, at the Bunker Farm plots. Each replication contained eighteen hills and each hill was thinned to three plants. The "standard checks" were one local New Hampshire flint, one dent-flint hybrid, Maine "B", and one open-pollinated dent, "New Hampshire 500".

The ears were harvested on October 17 and the weights of each replication yield recorded. Four ears were selected at random from each replication for drying down to a uniform moisture content. A uniform moisture basis was used to calculate the moisture loss and yield per acre of grain.

In this eleventh year of the grain trials, the weather, previous to harvesting, was rainy and wet. The corn kernels did not harden off properly and the average moisture loss of 43.6 per cent was the highest recorded. Massachusetts Hybrid 62, Cornell 29-3, and some of the Wisconsin hybrids gave good returns. New Hampshire 500 and Wisconsin 279 were lower than usual, due to poor soil conditions of one replication.

In addition to the regular grain corn trials, 13 hybrids were grown in single rows for comparative observation. Some of these seed varieties show promise and will be repeated.

L. J. HIGGINS

Introducing New Potato Varieties for Certified Seed

In 1946, three relatively new varieties, namely, Mohawk, Ontario, and Pawnee, were tested by the tuber unit method. Pawnee is a high-yielding, mid-season variety and Mohawk is a high-yielding, late variety. Mohawk has proved to be susceptible to leaf-roll but in other respects it seems a highly desirable variety. It is a smooth white potato and produces a remarkable high percentage of marketable tubers. It is excellent in cooking quality. The Ontario is resistant to scab.

All were included in a variety test of 25 strains of potatoes during the 1946 season. Three new blight-resistant strains introduced from New York State stood at the head of the list for yield, largely because an uncontrolled severe blight outbreak in August cut the growing season for the rest of the varieties. These blight-resistant varieties proved to be resistant on foliage but not on tubers. Whether or not they will assume any importance, commercially, is still questionable. Empire was the lowest in respect to tuber infection but it has a higher quality rating. Two other blight-resistant varieties, Chenango and Placid, have been added for testing in 1947. Current tests include only 15 varieties because the undesirable varieties have been discarded. Five varieties are being tuber united for foundation stock.

P. T. BLOOD, L. T. KARDOS, M. C. RICHARDS
L. J. HIGGINS, F. S. PRINCE

Proper Construction of Farm and Commercial Potato Storages

The use of carbon dioxide gas as a sprout retardant in potato storages was continued on a bin scale. Approximately 260 bushels of graded Katahdin table-stock potatoes were loaded into the bin which was of reasonably tight wood construction.

After several weeks it became apparent that excessive quatities of CO_2 gas had to be supplied to attain adequate CO_2 concentrations in the bin. As the temperature in the bin rose with the passage of the spring season, the tubers themselves supplied an increasing amount of the necessary CO_2. At the close of the experimental period, with only moderate additions of CO_2 from a compressed gas cylinder, a concentration of about 8 per cent CO_2 was attained in the bin.

Upon opening the bin, the degree of sprouting found indicated that the ordinary wood construction employed did not maintain a concentration of 10 to 12 per cent CO_2 in the bin, and therefore, was not suitable as a sprout retardant bin. The results did indicate, however, that there was adequate gas diffusion within the bin and that with more rigid specifications in construction, an adequate CO_2 concentration to prevent sprouting may be maintained.

P. T. BLOOD, L. T. KARDOS

Drying Young Grass for Use as a Grain Substitute

This project was started in the summer of 1946 with the building of a small 9′ x 9′ house, equipped with 4′ x 9′ trays for holding grass and a pot-type oil burner installed as the heating unit. This provided maximum capacity for 150 pounds of dried grass. The heating unit proved slow and inefficient, the time required to dry the average amount of grass being approxi-

mately 48 hours. Wet grass dried more slowly. In fact, it often molded unless it was turned during the drying process.

After each batch was dried, it was run through a hammermill and bagged for feeding. A total of about one ton of material was obtained. This is now being fed to cows experimentally and under supervision.

F. S. PRINCE, P. T. BLOOD

DAIRYING

Relationship of the Composition of Milk to Methods Used for Determining Adulteration

A study was made of the relationship between milk composition and the results of tests used to detect added water. One hundred-and-thirty individual milk samples were analyzed for fat (both Mojonnier and Babcock methods), total solids, and solids-not-fat. The added water tests which were carried out on the same samples included the determination of the freezing point depression, refractive index of the acetic and copper sera, and ash of the acetic serum. Some of the samples were chosen because of known low composition.

The following table summarizes, in the form of group averages, the results obtained:

Number of samples	Per cent fat		Per cent S. N. F.	Per cent T. S.	Refractometer Reading		Per cent Ash serum
	Babcock	Mojonnier			Acetic serum	Copper serum	
10	2.88	2.90	7.66	10.56	38.9	35.7	.793
12	3.23	3.35	7.86	11.21	40.6	37.6	.771
14	3.39	3.41	8.26	11.67	40.5	36.5	.777
2	3.50	3.57	8.31	11.88	40.7	38.0	.699
92	3.68	3.71	8.63	12.34	41.7	37.9	.766
130	3.55	3.58	8.44	12.02	41.2	37.5	.768

All samples showed a normal freezing point depression, indicating that none of the samples were adulterated with water. Ten of the samples had refractometer readings indicating added water. Acetic acid reading below 39 and copper serum reading below 36 indicated added water, according to Standard Methods. These 10 samples averaged 38.9 for the acetic serum reading and 35.7 for the copper serum reading. Acetic serum ash averaged 0.793, which did not indicate added water. The average composition of these ten samples was: fat (by Babcock) 2.88 per cent; fat (by Mojonnier) 2.90 per cent; S.N.F., 7.66 per cent; and total solids, 10.56 per cent. The refractometer readings on another group of 12 samples, with a S.N.F. average of 7.86 per cent, did not indicate added water.

A group of 14 samples, all having a copper serum reading between 36.0 and 36.9, had an average solids-not-fat content of 8.26 per cent again indicating that low-solids milk is likely to show a low refractometer reading. Only two samples had a serum ash content that would indicate added water; but the refractometer readings on these two samples were in the range for normal milk.

Of all the samples analyzed, 38 had a low solids-not-fat content, and these either had a refractometer reading that indicated added water or the readings were in the low range.

This study has shown that it is possible to obtain low refractometer readings on unadulterated milk samples having a low composition solids-not-fat.

H. C. MOORE, H. A. KEENER, A. E. TEERI

Cobalt Treatment of a Nutritional Disease of New Hampshire Cattle, Sheep, and Goats

When a low cobalt New Hampshire hay was fed in a paired sheep experiment, those animals which received the equivalent of 2 *mg.* of cobalt per day gained approximately 2½ times as much as the animals which received no cobalt. Cobalt tolerance studies with growing dairy cattle have also been completed. This work indicates that such animals may be fed cobalt up to levels of nearly 50 *mg.* per 100 pounds of body weight per day for periods of many weeks before harmful effects are produced. An experiment is now being carried out with sheep in an attempt to learn more concerning the functions of cobalt in the diet.

Chemical studies on forage samples taken from various parts of New Hampshire substantiate the previous observation of widespread cobalt deficiency in cattle, sheep, and goats throughout most of the state.

An experiment to determine the effect of various fertilizer and cobalt treatments of the soil on the cobalt content of the forage was started this year.

This project is being carried out in co-operation with the U. S. Plant Soil and Nutrition Laboratory, Ithaca, N. Y.

H. A. KEENER, G. P. PERCIVAL, K. S. MORROW

Supplemental Vitamin D for Dairy Cows

This experiment is being conducted in order to determine whether or not lactating dairy cows under farm conditions in this area are benefited by the feeding of supplemental vitamin D.

A herd of 40 cows is being used. The cows are divided into three groups, each member of one getting 15,000 I. U. of supplemental vitamin D per day from irradiated yeast; those of another 50,000 I. U. of supplemental vitamin D per day from the same source; while the members of the third group are kept as controls. Results are based on chemical studies of the blood, vitamin D assays on the blood and on the various roughages, and on the production and general well-being of the cows. The experiment has not progressed far enough to warrant any conclusions.

This project is being partially supported by the Wirthmore Research Grant and by the Standard Brands Research Grant.

H. A. KEENER, K. S. MORROW

The Relation of Trace Minerals to Vitamin Synthesis in the Rumen of Dairy Animals

Two experiments are under way in order to determine a satisfactory method for assessing the relation of trace minerals to vitamin synthesis in

the digestive tract. Daily urinary and fecal excretion of thiamine and riboflavin were determined for two Holstein heifers under normal conditions and when sulfathaladine was fed to alter the flora of the digestive tract. Some decrease in the excretion of thiamine and riboflavin was observed during the feeding of the sulfathalidine. Work to date indicates the possibility of using urinary and fecal analyses for measuring vitamin synthesis in the digestive tract.

K. S. MORROW, H. A. KEENER, A. E. TEERI

Studies on Bovine Mastitis

Studies were continued on the treatment of bovine mastitis with penicillin. A special effort was made to determine the efficacy of one infusion of 400,000 units of penicillin for the treatment of streptococcal mastitis. The penicillin was administered via the teat canal in 100 *ml.* of sterile water. Attention was also given to the use of sulfamethazine for the treatment of streptococcal mastitis.

One infusion of 400,000 units of penicillin was as effective as the administration of several smaller doses of penicillin for the treatment of streptococcal mastitis. In a group of 21 cows with the advanced, chronic or the acute type of streptococcal mastitis, 85.7 per cent of the cows and 90 per cent of the infected quarters were cured. These types of mastitis are most difficult to cure. Some evidence was obtained that practically 100 per cent cures may be produced if the quarters are not milked until 24 hours after treatment. When used in combination with penicillin, sulfamethazine did not appear to appreciably increase the percentage of cures. The major portion of this work is reported in a paper entitled "Further Studies on the Treatment of Bovine Mastitis with Penicillin" and is now in press for the Journal of American Veterinary Medical Association.

L. W. SLANETZ, F. E. ALLEN

ENTOMOLOGY

Penetration and Toxicity of Contact Insecticides

The study of the effect of various compounds on the toxicity of insecticides in present use was begun in the fall of 1946. In seeking to improve the performance of pyrethrum, exploratory tests were made with 44 chemicals in combination with pyrethrum. Chemicals examined included various alcohols, cellosolves, phthalates, vegetable oils, and salicylates. These materials were prepared in the form of household sprays and were applied on the common housefly.

Of the 44 chemicals used, 10 showed synergistic action, when used in combination with a pyrethrum fly spray. Eleven compounds showed no effect or exhibited a slight antagonistic effect, while the rest showed some tendency to increase the toxicity of the spray.

The salicylates which showed marked toxicity in initial tests were examined in greater detail. Various combinations of the sprays and the synergists were tested to determine the best possible concentrations for use in a fly spray.

Chemicals showing marked synergistic action were phenyl cellosolve, cellosolve salicylate, phenyl salicylate, butyl carbitol acetate, 2-ethyl hexandiol, and six of the high molecular weight phthalates. Within the series of salicylates tested, the order of synergistic activity showed direct increase in molecular weight of the compounds. The higher the molecular weight the greater the synergistic activity. Phenyl salicylate and cellosolve salicylate showed greater synergism than did Sesame oil, but were somewhat inferior to piperonyl cyclohexanone.

It is planned to investigate synergists further with the possibility of increased toxicity of pyrethrum rotenone and Lethane. As opportunity offers it is also planned to investigate possible synergists for DDT and bezene hexachloride.

In co-operation with the Crop Protection Institute, benzene hexachloride has been investigated to determine its toxicity against various insects. In preliminary tests benzene hexachloride gave promising results in the control of bark beetles attacking freshly-cut pine logs. This work is of considerable interest in view of the present threat of the Dutch elm disease, which is transmitted by a bark beetle and which might conceivably be susceptible to insecticidal applications, thus reducing the chances for spread of this important disease.

A dust containing one per cent of the gamma isomer of benzene hexachloride proved ineffective in an attempt to control a heavy infestation of the eye-spotted bud moth of apple. The application was made after many of the budworms were already tightly enclosed in rolled leaves.

During the past year an improved method of applying dusts in the laboratory was developed in co-operation with the Crop Protection Institute. The method involves the use of a partial vacuum in obtaining a very uniform deposit of dust on potted plants, or insects in a bell jar. Dust deposits applied by this method appear to be remarkably uniform, and the method has already found favor with other laboratories engaged in research of the insecticides or fungicides. Plans are underway to attempt to secure this same kind of uniform deposit when liquid spray applications are used.

During the year, apparatus has been devised for investigating the use of flourescent materials in photographing spray deposits as a means of obtaining more accurate appraisal of new insecticides and fungicides applied under field conditions.

J. G. CONKLIN, W. C. O'KANE, R. L. BLICKLE, W. J. MORSE

Insect Record

Scouting of birch stands in Coos County was carried on in 1946. to determine to what extent the bronze birch borer was causing damage. The insect was found to be present in outbreak form, particularly in the Pittsburg area. Some stands of considerable size were found to be as high as 90 per cent infested with the borer; although mortality is not yet serious. it is believed that prompt salvage of infested trees will be necessary if much of the yellow birch in the area is to be saved.

Light trap larval and adult biting collections of mosquitoes were made during the summer of 1946. A total of seven genera and 29 species were taken. The most common species in point of numbers were *Mansonia per-*

turbans, Edes stimulans, and *E. vexans.* A total of 17 species of *Edes* were collected. The remaining genera were represented as follows:

Anopheles, 3 species
Culex, 4 species
Culiseta, 2 species
Uranotaenia, Mansonia, and *Wyeomyia,* 1 species each

During the summer of 1946, the eye-spotted budmoth was found to be on the increase in apple orchards in the Souhegan valley area. In the spring of 1947, the insect was found to be quite prevalent throughout the southern part of the state, and apparently is increasing.

J. G. CONKLIN, R. L. BLICKLE, W. J. MORSE

Apple Maggot

Experimental work on this project had to be curtailed in 1946 because of a crop failure in the experimental orchard. This was brought about by severe frost, late in the spring. Observations on apple maggot activity and insecticidal control were made as opportunity offered.

Dust containing 5 per cent of DDT, applied in three applications, gave good control of the apple maggot in two orchards which had a fair crop, and where arsenate of lead had in previous years given unsatisfactory results.

J. G. CONKLIN

Studies of Insects Affecting Spruces

During the summer of 1946, an effort was made to detect spruce budworm activity in some 30 permanent observation plots, which had been established in the spruce-fir area of the state. The insect was not found in any of the observation plots. However, a few specimens of the budworm were found in outside areas in Pittsburg. In no case was defoliation evident.

Because of the continued spread of the spruce budworm in Canada, Maine, and New York, it is planned to carry on more intensive scouting to detect the presence of the budworm in 1947.

The European spruce sawfly was again found to be present in very small numbers in spruce areas in 1946, but no actual defoliation was observed in any of the areas examined.

J. G. CONKLIN

Proposed Study of Spray and Dust Deposits

Apparatus has been installed in a darkroom for the utilization of fluorescence by means of photography. This includes suitable transformers and a pair of high intensity ultra-violet lamps mounted on an adjustable rigid stand. The impact of ultra-violet rays causes emission of light of longer wave lengths. These are capable of photography. A camera, which is provided with extension tubes and a filter designed to prevent ultra-violet reflections from reaching sensitive film, is available. It is expected that both panchromatic film and kodachrome will be used.

As a preliminary groundwork the various chemical compounds now in use as insecticides or fungicides will be examined for autofluorescence. Many compounds under ultra-violet become luminescent. Fundamental informa-

tion will be sought as to the compounds possessing this property. For example, various mineral oils will fluoresce. Various copper compounds exhibit a characteristic luminescence.

In the absence of this property it is proposed to treat a compound with a fluorochrome which will impart to it the ability to fluoresce. A long list of fluorochromes has been recorded in the literature. Some of them are soluble in water, some only in selected organic solvents, while some exhibit increased fluorescence when highly diluted or extended.

With preliminary data at hand it is proposed to study leaves which have been subjected to sprays or dusts under controlled conditions, in the department laboratories or greenhouse. It is hoped that photographs may be secured which will show in detail the nature and extent of deposits not otherwise adequately visible. If this stage of the investigation is successful, a further study will be undertaken involving deposits remaining on foliage after artificial rain.

The relationship of the nature of the deposit to its performance as an insecticide will then logically be in order. Through co-operation with plant pathologists the relationship of deposits of fungicides will be sought. Subsequently, it may be possible to add a fluorochrome to sprays or dusts applied under field conditions. It is hoped that leaves from sprayed or dusted plants may then be detached and brought to the laboratory for study and for photographic record.

W. C. O'KANE

FORESTRY

Sugar Maple Propagation

About 1500 cuttings were gathered from high-yielding trees and placed in sand in both outdoor and indoor beds. Particular emphasis was placed on treatment of the cuttings with ammonium salts of organic acids possessing hormone-like properties. These were indole-3-butyric acid and p-chlorophenoxy acetic acid. Some were treated with a new hormone powder, Dow "Quick-root" No. 2.

Certain individual treatments gave as high as 20 per cent rooting, but the total number was only 15 cuttings, or about one per cent of the total. To date no success has been attained in carrying the rooted cuttings on to produce larger trees. The small number rooted each year has prevented much experimentation with variable factors affecting this.

The seedlings from high-yielding trees appear to be doing well, but have not made enough growth to justify setting them out in the spring of 1947. They will remain in the transplant beds for another year.

S. DUNN, C. L. STEVENS

Characteristics of Sap Flow

The daily flow from two sugar maples and one gray birch was measured throughout the winter from October 23 to April 28. Thermographs recorded temperatures inside the trees, in the soil at the base of the trees, and in the air nearby. On five occasions, during the spring, the sap flow was measured

every half hour during the day. The sugar content and the acidity of the sap were measured at frequent intervals by the staff of the Engineering Station, co-operating.

The data have not been subjected to close study, but some conclusions are apparent. Maple sap flowed reasonably well during the test on days in which correct weather conditions prevailed. The rapidity of flow closely followed changes in weather on those days in which the half-hourly flow was measured. There seems to have been a gradual increase of the sugar content during the winter, reaching a peak at about the start of the spring run.

The sap of gray birch follows a somewhat different schedule, but the controlling weather conditions have not been determined. Samples tested for sugar content showed less than one per cent sugar, while the pH content decreased from 6.4, on April 5, to 4.5, on April 25. There was some fluctuation but otherwise the progression was fairly regular.

C. L. STEVENS

Reproduction Studies

Current work involves routine measurements of plantations up to five years old, and the establishment of four new ones, including one of game-food species.

1946 was not a good seed year, but 73 seed tests were conducted: 38 on 12 species and one variety of conifers and 35 on 20 species of hardwoods. Nothing could be done, however, on the quantity and quality of seed production by local species. No data were collected on sprout reproduction.

C. L. STEVENS

White Pine Stands

Using two standard methods of thinning, a little over eight acres of pine were thinned. About five acres were pruned, and there was a small reproduction cutting based on the Selection System.

C. L. STEVENS

Devices and Implements Useful in Farm Logging

The activities carried on under this project have included studies of:

1. Loading bundles of logs for transportation to saw-mill
2. Loader adapted from gasoline-operated, ditch-digging shovel
3. New application of conical splitting wedge previously reported
4. Supplying information and photographic enlargements of several devices on which studies have been made

Several methods were tried for loading standard bundles of logs, whereby relatively small logs could be moved cheaply from forests where thinning operations are being conducted. Owing to the length of time required to handle these logs in the customary manner, it was found that loads could be made up in bundles, secured by chains, and that they could be loaded directly on trucks with a loader adapted from a ditch-digger. This operation appears to be economically sound. Another type of loader made in a similar manner was used for loading hardwood logs directly from the ground. Con-

siderable time and expense are saved because no standard log-deck is needed for truck loading under this system.

With reference to the conical splitting wedge previously reported, one company has mounted a similarly made wedge on the power take-off of a standard wheel tractor. Further study will be made of this interesting adaptation.

During the year, exhibits on labor-saving equipment have been shown throughout the state under the auspices of the Agricultural Extension Service. Information was supplied to the exhibitors with reference to devices which have been described. Photographs were made available to the exhibitors.

L. C. SWAIN

FRUITS

Leaf Scorch in Deciduous Fruit Plantings

Sod culture, and hay, sawdust, or seaweed used as mulch have had no differential effect on leaf scorch of apple trees. None of the treatments has reduced the severity of leaf scorch on McIntosh apple trees under test. The type of leaf scorch studied is apparently related to the interaction of potassium, calcium, and magnesium in the soil and in the three. The soil of the block under test in the University orchard runs high in potassium and is relatively well supplied with magnesium, yet chemical analysis shows that the trees are deficient in magnesium. Leaf scorch occurs when the magnesium content of the leaves falls to 0.19 per cent or 0.18 per cent dry weight basis.

McIntosh seedlings grown in culture solution in the greenhouse failed to send out new roots and then died when the nutrient was supplied with magnesium sulfate, due possibly to the low pH of the medium. Magnesium ammonium phosphate, however, resulted in the development of new roots and some leaf growth of the seedlings. Some promise is shown in the use of organic forms of magnesium.

L. P. LATIMER, G. P. PERCIVAL, S. DUNN

Body Stocks and Understocks for New Hampshire Apples

Cortlands and McIntosh came into bearing on all trees that were seven years old this year. The Virginia Crab and Florence Crab apple trees worked to Cortland and McIntosh are bearing as much fruit as the same varieties on Malling No. 4 roots or on seedling roots. All trees are seven years old.

Robosta trees used for a body stock are self-rooted and have been difficult to train into well-shaped trees due to their bush type of growth. However, they take the scion well, and up to the present time, make excellent trees. They are four years old, and were top-worked two years ago.

Northern Spy and McIntosh are fruiting heavily on Malling No. 1, at the age of eight years.

W. W. SMITH

Blueberry Culture

Plots were started this year in the dry sandy plains at Madison. The area is covered with blueberry bushes and it has responded well to burning. Spring frosts and summer droughts are still to be evaluated as ecological factors.

The species of blueberry, *Vaccinium canadense*, predominates the northern third of New Hampshire and seems to escape spring frost which may be due to resistance of the plant blossoms to low temperatures or to later blossoming than the species *(Vaccinium angustifolium)* found in central New Hampshire.

Further studies of controlling weeds in blueberry fields led to the use of weed-killing chemicals. Sulfamate used at concentration as dilute as $\frac{1}{32}$ pound per gallon was found toxic to the blueberry plant.

Boron crystals broadcasted at the rate of one pound per 100 square feet killed hardhack *(Spiraea tomentosa)* without injury to blueberry plants.

2,4-D when diluted with water to 300 *ppm* of the 2,4-Dichlorophenoxyacetic acid, killed sweet fern *(Comptonia peregrina)* without injury to blueberry plants, but higher concentrations resulted in some injury. There was evidence in a commercial blueberry field treated with a 7-7-7 fertilizer at the rate of 1000 pounds per acre that the blossoms resisted spring frost more than did blueberry blossoms in unfertilized areas.

W. W. SMITH

Breeding Work and Varietal Tests

The Van Buren, Fredonia, Kendaia, and Worden grape varieties maintained their position at the head of the list for varieties adapted to the climate of southern New Hampshire. These varieties are too tender for growing in the north without winter protection.

An everbearing red raspberry resulting from Taylor seed pollinated with Nectarberry has been introduced. It is a very firm berry which begins ripening its fall crop by August 20. The fall fruiting area is often two feet or more in length hence there is a possibility of a paying crop on new wood.

Peach seedlings from hybrids made in 1944 by the use of North Caucasus peach pollen sent in by mail from Beltsville, Maryland, and used on commercial varieties at Durham have made an unusual growth. They have a good crop of fruit set in 1947, which is their third year from seed. One of the seedlings is a cross between Peen-to and the North Caucasus peaches. The characteristic shape of Peen-to predominates.

Hybrids and back crosses of strawberries involving wild hybrids and late hybrids show promise for high yield, good quality and freedom from disease.

A. F. YEAGER, L. P. LATIMER

Cultural Practices

Since first applying the mulch treatments it has been found that total yield has been greatest on trees mulched with hay and lowest on unmulched trees. Foliage has been paler green in color on sod and sawdust mulched trees and twig growth has been greatest with hay mulch. In other charac-

teristics, little difference due to treatment has been noted. Twenty-five-year-old Northern Spy apple trees, unfertilized but mulched with hay, continue to produce much better than those grown in sod only and fertilized. The average increased production over a period of years has been six bushels per tree per year.

Trials to determine the extent of bruises and injuries to McIntosh apples from picking were made under similar conditions, using canvas picking bags and metal-sided, open-bottom type of bucket. Data taken at the termination of the storage period on fifteen 100-apple samples gave 44.5 bruises of one-half inch or less in diameter, and 2.3 bruises over one-half inch in diameter, per 100 apples when picked into canvas bags. Apples picked into metal-sided buckets showed 37.5 and 3.3 bruises, respectively, per 100 apples.

L. P. LATIMER, A. F. YEAGER, C. L. CALAHAN

ORNAMENTALS

Chrysanthemum Variety Tests

In a variety test of hardy chrysanthemums consisting of 138 varieties which were not protected by mulching during the winter, the following were rated in the spring of 1947 as fully hardy: Sundance, Little Eskimo, Bambi, Igloo, William Longland, White Knight, Pipestone, Aviator, White Gold, Morning Star, Welcome, Snowball, and two unnamed white seedlings of the University of New Hampshire designated as H-1-45 and H-6-45. Varieties listed as second degree hardiness (that is, which survived well enough to make good sprouts): Glowing Coals, Thala, Courageous, Rose Spoon, Red Ridinghood, Primula, Yellow Spoon, Flash, Red Gold, Bonfire, Eggshell, Stewart, Dean Ladd, Harmony, and R. C. Cummings. The other 109 varieties killed out completely during the winter. Through an oversight, the named New Hampshire introductions were not given a comparable test this year.

A. F. YEAGER, P. MOORENOVICH

Lilac Culture

The lilac arboretum, which was badly infested with oyster-shell scale, was cleared up satisfactorily by the use of Elgetol while in a dormant condition. New lilac seedlings of late-blooming types began blooming in 1947 from plants grown from seed in 1945. A plant resulting from a cross made by Henry Clapp between *Syringa japonica* and *Syringa vulgaris* is making satisfactory growth but as yet has produced no blossoms.

A. F. YEAGER

PASTURES

Producing the Full Roughage Requirements on New Hampshire Dairy Farms with Special Reference to Pastures

It is the purpose of this project to determine which of the tall grasses is best suited for seeding with ladino and whether or not any of the newer ones are superior to timothy, the most common grass.

The work, so far, has been conducted on privately owned farms. Original seedings were made on relatively small plots, usually less than an acre. It was found difficult to fence and pasture at the time when individual grasses should be grazed. Later seedings have been made with each grass on a field scale with plots large enough to fence economically. Obviously, this increases differences due to soil variations.

Six outlying pastures were harvested in 1946 and yields were determined for the six grasses under study, all of which had been seeded individually with ladino clover in 1942 or 1943. Variations in yields among the six grasses were small, there being but .36 ton difference between smooth brome (the highest) and reed canary, (the lowest). The fact that ladino was seeded with each one tends, no doubt, to iron out yield variations.

Reed canary and tall fescue appear to offer the most competition to ladino. Tall fescue makes the most growth in late fall, while the growth of orchard grass is disappointing at this period. Perennial rye is more ephemeral than the other grasses; its place is taken more quickly by bluegrass and bent grasses than the others. The suggested rank, with respect to palatability, in descending order is as follows: smooth brome, timothy, perennial rye, orchard grass, tall fescue and reed canary. As a result of these trials, farmers on whose farms the tests are located are making an increasing number of brome grass seedings. Comparative tests with complex mixtures containing ladino, Kentucky bluegrass, and red top have not yielded as well as the simple mixtures noted above.

F. S. PRINCE, P. T. BLOOD, G. P. PERCIVAL

The Use of Herbicides in New Hampshire With Particular Reference to Pastures

During the year 1946-47, the treatments made during 1945-46 were continued in general. However, successful treatment of Bindweed with 2,4-D during the preceding year was so satisfactory that no further research was needed; further research on the Buttercup confirmed the previous year's conclusion that Ammonium sulfamate, at three ounces per gallon of water, is the most effective herbicide and, for best results, should be applied at the time when the plant has just finished flowering. Treatments of poison ivy, in early July and again in late July, with Ammate at ¾-pound gallon in deep shade gave perfect control. Plots laid out at the same time and treated with the ammonium salt of 2,4-D under comparable conditions gave very nearly perfect control. Therefore, for early and mid-summer treatments, it seems advisable to recommend the 2,4-D herbicides as well as Ammate and Borax for poison-ivy control. One necessary condition for both Ammonium sulfamate and 2,4-D control of poison ivy would seem to be thorough coverage. Late spring treatments of poison ivy, using Borax, Ammonium sulfamate, and 2,4-D in two forms (ammonium salt and methyl ester) have been made in 1947. Thus far, the results would seem to be satisfactory for early to mid-June applications of either 2,4-D or Ammate.

Experiments on the control of winter cress or yellow rocket indicate that applications of 2,4-D herbicides are most effective when made at about the time of full flowering but before seed-pods are set. Ammonium sulfamate at three ounces per gallon of water also proved very effective. 2,4-D has

some harmful effects on clovers, and Ammonium sulfamate is definitely destructive to them and has some retarding effect on grasses as well. In fields having light to medium infestation, spot-spraying with a small tank sprayer, using either Ammate or 2,4-D, was found to be entirely satisfactory.

In middle and late summer, Canada thistle was killed to the ground readily by Ammonium sulfamate at three ounces per gallon of water. The 2,4-D compounds also showed some promise. Again, the most successful kills were made at the time of flowering. Two species of Devil's paintbrush, or yellow hawkweed, have been successfully treated with herbicides. The species are the low-growing and almost mat-like spreading Mouse-ear Hawkweed found mostly in pastures and lawns and the taller-growing and less spreading so-called Yellow Devil which abounds in fields as well as pastures. Both species are susceptible to Ammonium sulfamate and 2,4-D containing compounds. Very excellent control was achieved by late spring and early summer applications of Ammonium sulfamate at three ounces per gallon of water and 2,4-D at the usual recommended strength (1000 parts per million in water solution). The ester of 2,4-D proved somewhat more effective than the ammonium salt.

Attention also was directed to Junipers. Preliminary work indicated that Borax may be effective but slow in action and that Ammonium sulfamate is very satisfactory at certain seasons.

A. R. HODGDON

Pasture Management

Results of pasture and crop improvement on organization and operation of farms are shown by the data from two farms of the 20 studied. In 1937, both farms were operated by older men who were nearly ready to retire. Upon the advice of a son of the owner, one farm was reorganized. The improvement and enlargement of pasture and cropland were necessary complements to a larger herd of cows. This made it necessary to remodel the old barn in order to provide more room for stock and for hay storage.

The second farm was purchased by a younger man and combined with his own smaller one, where he had started a large amount of pasture-management work. This is now used for pasturing young stock. The pasture on the home place has been enlarged and improved to care for a larger herd. These improvements also necessitated remodeling the barn.

Production of both milk and roughage has increased on these two farms by about half, with no increase in labor hired. Both have adopted rapid milking.

One farm has increased the number of milkers from 19 to 32, the second from 26 to 36. Total milk production has increased from 116,698 pounds to 215,008 pounds on the first farm, and from 148,460 pounds to 217,160 pounds on the second farm. Grain consumption has increased with the larger herd and with higher production but has decreased per hundred pounds of milk produced. For the two farms, grain per hundred pounds of milk produced has been reduced from 25.6 pounds to 23.8 pounds and from 25.0 to 21.8 pounds.

The shift to more legume hay has raised problems of harvest and added some conflicts in operation, so that there is more emphasis placed on grass silage.

M. F. ABELL

PLANT PATHOLOGY

Factors Influencing the Development or Suppression of Leaf Roll Symptoms in Potato Foliage in the Greenhouse

Green mountain seed pieces, known to be infected with the potato leaf roll virus, do not always produce plants showing the leaf-roll symptom when they are grown in the greenhouse during the winter months. It can be demonstrated that the leaf-roll symptom may be suppressed, or entirely masked in some cases, by adding nitrogenous fertilizers to the soil at planting time. On the other hand, the symptom may be accentuated by the application of phosphate nutrients. Such results are obtained under greenhouse conditions during the winter months. They were not reproducible under field conditions during the summer.

When a number of infected tubers were planted (each tuber in a separate pot) the degree of symptom expression was not the same in all cases. The leaf-rolling symptom varied from healthy to slight, moderate to severe. Therefore, with the addition of nitrogenous fertilizers, there was a tendency for most of the plants to be normal or show only a slight rolling of the leaves. Similar symptoms were obtained when infected tubers were planted in pots of different sizes and in beds. Plants developing from infected tubers were larger, and a higher percentage of them showed more severe leaf rolling when grown in eight-inch glazed pots or in plant beds than when grown in six-, five- or three-inch unglazed pots. Plants in the unglazed pots were smaller in size and greener in color.

Plants with severe symptoms retained starch in the rolled leaves for as long as 60 hours after being placed in the dark. Healthy plants and virus-infected plants with unrolled leaves lost all starch from their leaf tissues in less than 12 hours.

The higher nitrogen content of the soil in combination with the low light intensities during the winter months probably suppresses starch accumulation in the leaves and thus prevents the rolling of leaves to varying degrees.

M. C. RICHARDS

The Control of Tomato Diseases

Alternaria blight and late blight continue to be the most important diseases of tomatoes in New Hampshire. Investigations to discover plants resistant to these diseases have been continued. Tomato seeds obtained from the Division of Plant Exploration and Introduction, United States Department of Agriculture, have been planted and tested for resistance to both diseases; as yet no species having sufficient resistance to warrant its use for plant breeding purposes has been found.

Tests were made to determine the effects of organic and inorganic fertilizers on the incidence of Alternaria blight on Marglobe and New Hamp-

shire Victor tomatoes. The following treatments were made at planting time: (1) 5-10-10 fertilizer in bands at the rate of 600 pounds per acre, (2) a shovel of well-rotted manure, (3) manure plus superphosphate, (4) Ammonium nitrate in water and supplied to the plants during the growing season, (5) check. The plants were sprayed with DDT to control insects but no fungicides were used.

Complete defoliation occurred on the plants in all treatments by September 13. The number of pounds of marketable fruits per plant from the plots was as follows: New Hampshire Victor check plots 8.7; Manure only 12.9; Manure plus superphosphate 11.5; 5-10-10 fertilizer 10.7 and Ammonium nitrate in water 9.2. For Marglobe check 3.6 ;manure 4.7; manure plus phosphate 4.7; 5-10-10 fertilizer 7.2, and Ammonium nitrate in water 4.6.

The defoliation of the plants by Alternaria blight was not significantly changed by the fertilizer treatments. The yields, however, were affected as shown.

M. C. RICHARDS

Plant Disease Investigations

Spur blight continues to be a prevalent disease of raspberries in New Hampshire. Spray applications were made this year as follows: April 15—Elgetol ¾-100, to all plots except the checks. June 6 and August 15—Fermate 2-100, Phygon 1-100 and Puratized 1 pint-100 followed by Fermate 2-100. The Latham variety showed a slightly higher percentage of infected canes than Viking or Taylor. On September 3, 1946, the average number of diseased canes for the three varieties was as follows: Elgetol-Fermate, 33.3 per cent; Elgetol-Phygon, 36.9 per cent; Elgetol-Puratized-Fermate 37.8 per cent, and Check 58.3 per cent.

Whether or not a relationship exists between spur blight and winter injury is not known. There were about half as many canes this year as last, though a considerable amount of injury occurred this past winter to all three varieties.

Tomato plants which were tied to stakes smeared with juice from mosaic-infected plants in September, 1946, developed a few more mosaic plants than those tied to new stakes. Plantings were made in the greenhouse in April, 1947. In handling the plants, care was taken not to spread the mosaic from plant to plant or from plot to plot.

M. C. RICHARDS

Testing New Pesticides

Certain fungicides which have been used for the control of various diseases were tested, this year, in comparison with some of the newer organic and inorganic fungicides. Fungicides used in the spray tests were as follows: Zerlate, *(zinc dimethyl dithiocarbamate);* Fermate, *(Ferric dimethyl dithiocarbamate);* Phygon, *(Dichloronaphoquinone);* Manganese ethylene bisdithiocarbamate; Parzate, *(Zinc ethylene bisdithiocarbamate);* Puratized, *(Phenyl mercuri triethanol ammonium lactate);* Tribasic copper sulfate; and Bordeaux mixture, 10-10-100, and 10-5-100.

On Green Mountain potatoes Zerlate, Parzate, and Manganese ethylene bisdithiocarbamate gave the best control of early blight as well as the best yields. With the Irish Cobbler variety Parzate and Bordeaux mixture gave the best control of early blight, but Tribasic copper sulfate and manganese ethylene bisdithiocarbamate gave the best yields. Phygon used at two pounds per hundred gallons of water gave good control of early blight but cut yields below that of the check.

On New Hampshire Victor tomatoes Bordeaux mixture, 6-6-100; Parzate (2-100) gave the best control of early blight, but highest yields were obtained from the plant sprayed with Fermate, (2-100); Manganese ethylene bisdithiocarbamate, 2-100; and Phygon, 2-100.

Puratized Agricultural Spray gave better control of apple scab on McIntosh trees and pear scab on Flemish Beauty than wettable sulfur. Where scab was prevalent on McIntosh leaves Puratized applied in combination with Arsenate of lead, 2-100, caused yellowing and abscission of the infected leaves. Under similar conditions greater injury to the foliage occurred when liquid lime sulfur 1½-100 was applied.

During the summer of 1946, DDT in the form of a 3 per cent dust was tested for European corn borer control in the field plots of sweet corn. The number of applications varied from one to four.

Corn harvested from plots which received four applications, a week apart, was entirely free of borer infestation. Where the fourth application was omitted 4 per cent of the ears were infested at harvest time. Satisfactory control was obtained in plots receiving only two applications, the first two in the series.

In seeking to obtain better control of potato aphids through the use of improved spray equipment, DDT in the form of a 50 per cent wettable powder was applied throughout the season to potato plots. An improved sprayer was designed to give better coverage to the underside of the foliage.

Better coverage of the potato foliage was attained than had been possible with the older conventional type of potato spray apparatus. Excellent control of potato insects was obtained. However, because of adverse weather conditions in August, which prevented normal build-up of this species, it was impossible to secure accurate information on control of the green peach aphid.

For a second season DDT in the form of a 3 per cent dust was applied to field-grown tomatoes in order to determine whether or not injury to the plants would result. In all cases excellent control of flea beetles was secured without any apparent injury to the plants, and with no apparent reduction in yield of tomatoes.

M. C. RICHARDS, J. G. CONKLIN

POULTRY HUSBANDRY

Protein Requirements of Chickens at Various Stages of Growth and Development

The last phase of this study has been concerned with the pH of the gastro-intestinal tract. Data on 247 chickens from 16 days to 101 days of age have been taken with nearly 5,900 pH readings recorded. Compilation and

analysis of the data are not yet complete so that only preliminary observations and statements can be made.

In the gizzard, the pH changes with age. In the early growth period the range is pH 2-3, but as the birds become older the range is pH 3-4, or a range of pH 4-5 in a few instances.

A comparison of the pH of the ceca of the same birds show that in 163 cases the pH of the two ceca differ in their entirety. In 79 cases one end was more alkaline than the corresponding end of the other caecum and in five birds the pH was the same for both ceca.

R. C. RINGROSE, T. B. CHARLES, S. R. SHIMER, H. A. DAVIS

A Study of the Cause and Prevention of Gizzard Lesions in Chickens

One of the major problems in this study has been uniform production of the gizzard lesion. Without uniform production of the lesion at a fairly high rate of incidence it is difficult to evaluate the effectiveness of control measures applied.

A semi-purified basal ration, which thus far has given results more uniform than the ration of natural feedstuffs previously used, has been developed. The basal ration contains 45 per cent of glucose. Thus, it is possible to substitute up to 45 per cent of the usual feedstuffs in the basal ration for test purposes without changing other ingredients in the basal ration. During the year, alfalfa leaf meal, ground oats, standard wheat middlings, wheat bran, cornmeal, cracked wheat, and soybean oil meal have been studied for their anti-gizzard lesion effect.

The results to date indicate that standard wheat middlings, wheat bran, and ground oats have some preventative effect under the test conditions. The other feedstuffs have not shown protective action.

R. C. RINGROSE, H. A. DAVIS

Choline in the Nutrition of Poultry

Egg yolk is one of the richest natural sources of choline, containing from 1.5 to 1.7 per cent of this compound. Poultry laying rations generally contain from .1 to .2 per cent of choline. Thus, there appears to be a choline deficiency for production purposes.

Poultry nutrition research has established that choline can be formed from other substances provided sufficient labile methyl groups are available. The amino acid methionine can supply labile methyl groups. It is possible, therefore, that one of the important functions of methionine may be to supply methyl groups for the formation of choline. In order to study some of these relationships the choline requirements of laying hens are being investigated.

A semi-purified ration has been developed for this study. It contains only a trace of choline by the analytical method used and contains .312 per cent of methionine and .067 per cent of cystine by calculation. The basal ration was supplemented with choline, methionine, and crystine in various combinations in experiments of relatively short duration. The control ration used was a commercially mixed laying mash.

To date, in those rations where choline has not been supplied, a serious loss of weight has occurred. Production was less seriously affected, but has been 6 per cent below the control which averaged 60 per cent. In the ration in which additional choline, methionine and crystine were supplied, production has averaged 70 per cent and weight maintenance has been as satisfactory as in the control group.

R. C. RINGROSE, H. A. DAVIS

Utilization of Sulphite Yeast as a Feedstuff for Poultry

Yeast for feeding purposes can now be made from the sulphite waste liquor from pulp and paper mills. The product contains about 50 per cent of protein and is a rich source of many vitamins required by poultry. During the year, a sufficient quantity of sulphite yeast was available for feeding experiments with chicks and laying hens. When used as the only protein supplement for chicks, sulphite yeast was approximately 20 per cent less efficient than soybean oil meal. The explanation for this appears to lie in the fact that, on the basis of present information, sulphite yeast contains about 20 per cent of non-protein nitrogen. Thus, when compared on an equivalent protein basis, sulphite yeast is less satisfactory for promoting growth. When 4 per cent of fish meal was added to the soybean oil meal and the sulphite yeast rations, growth on the latter was markedly improved but was still about 20 per cent less than on the soybean and fish meal ration.

When equal parts of the protein supplement necessary in the ration were supplied from sulphite yeast and soybean meal, growth was markedly improved over that on yeast alone. The combination was slightly better than the combination of yeast and fish meal although the difference was not statistically significant. Addition of 4 per cent of fish meal to the soybean-yeast combination resulted in further improvement in growth. Results on this ration with respect to growth, feed efficiency, and mortality were equal in all respects to the results obtained on the ration of soybean oil meal and fish meal.

The use of additional choline may be of importance in the utilization of the soybean-yeast protein combination. The results from one pen in which .25 per cent of choline chloride was added to the soybean-yeast protein combination without fish meal were intermediate between the growth results obtained with the soybean-yeast combination alone or when supplemented with 4 per cent of fish meal.

The availability and utilization of riboflavin and pantothenic acid from sulphite yeast by chicks have been studied. From the results obtained it is concluded that this product is a satisfactory source of these vitamins for the chick. Since the yeast was assayed for vitamin content by microbiological procedure, it is concluded that such assays are reliable for estimating riboflavin and pantothenic acid content in this product for poultry-feeding purposes.

Experiments with sulphite yeast for laying hens producing hatching eggs have also been carried out. Under the conditions of the experiments sulphite yeast was a satisfactory protein supplement for hens producing hatching eggs. With sulphite yeast as the only protein supplement production results, feed consumption, body weight maintenance, mortality, hatchability of

eggs ,and livability of chicks was equivalent to rations containing sulphite yeast and meat scrap or soybean oil meal and meat scrap. Sulphite yeast appears to contain the "animal protein factor" necessary for hatchability of eggs and growth of chicks. The riboflavin present in sulphite yeast is available to the hen and is satisfactory for meeting the needs for this vitamin for the production of eggs with high hatchability.

R. C. RINGROSE
(J. Seiberlich, Engineering Experiment Station, co-operating)

SOILS

Methods for Controlling Erosion on New Hampshire Potato Farms

A. Rainfall and Runoff at Northwood Ridge, N. H. (Runoff plots 70' x 14' with 7 per cent slope)

A total of 36.26 inches of rainfall occurred during 1946. This was approximately 2.8 inches below the normal amount at Durham which is 14 miles away. The maximum water loss during any one runoff was 2.92 inches and occurred as a result of a light rain upon a thawing 8-inch snow cover on frozen soil. The annual soil losses on this Paxton fine sandy loam were slight but the greatest loss occurred on a plot which has been in potatoes annually since 1940 without a winter cover crop.

B. Cropping and Soil Structure Data from Northwood Ridge Runoff Plots

The average potato yield on the winter rye plots was 7.9 per cent greater than that of the non-green manured plots and 3.4 per cent greater than that of the clover hay rotation plots. In the latter case, the potato crop was the second after plowing down an excellent clover-timothy sod.

Sod cores taken in 1943 from the runoff plots were subjected to three kinds of aggregate analyses: (1) gentle-dry sieving, (2) wet sieving of segregated aggregates having an initial size range of 3 to 5 *mm.* diameter. (3) wet sieving of a sub-sample having a wide range in initial aggregate and particle sizes.

The data obtained by using procedure 2 indicated that the aggregates retained on the 0.3 *mm.* and the 0.2 *mm.* sieves were least stable and that those retained on the 0.5 *mm.* sieve were most stable. Similar conclusions were derived from a comparison of the data obtained by using procedures 1 and 3.

Porosity values for the cores taken in 1943, 1944, and 1945 indicated no significant differences because of the widely fluctuating amount of stones greater than 4-mesh in diameter which was present. The percentage of these stones ranged from 4 per cent to 29 per cent of the total weight of the core.

C. Rotation Experiments at Strafford Ridge, N. H.

Of the plots cropped annually to potatoes, the winter rye plot led by approximately 40 bushels. Of the two-year rotations, the crimson clover plots outyielded the rye grass plots by approximately 35 bushels. Of the three-year rotations, there was relatively little difference in the yield of potatoes from the oats-clover hay and the oats-grass hay plots, with the clover rotation having a very slightly greater yield.

D. Subsoil Experiment at Northwood Ridge

The results for the unfertilized plots showed a decrease in yield of corn silage of 92.8 per cent when 100 per cent of the topsoil was removed and a decrease of 60.4 per cent when 50 per cent of the topsoil was removed.

Even where fertilizer was applied at the rate of 500 pounds of 5-10-10 per acre, the reductions in yield of corn were, respectively, 72.3 per cent and 49.8 per cent where 100 per cent and 50 per cent of the topsoil were removed.

E. Miscellaneous Aspects

During the course of the season, a noticeable difference in vigor appeared among the potato plots at both Northwood Ridge and Strafford Ridge. During the relatively wet August, it was noted that the vines on the plots which had recently received additions of organic matter were more resistant to early blight infection. At both experimental sites, the plots kept continuously in potatoes without organic additions were most heavily infected with early blight lesions.

L. T. KARDOS

The Influence of Soil Texture, Soil Moisture, and Soil Aeration on the Growth of Plants

Previous work showed that there was some benefit to cultures of tomatoes, potatoes, and onions from additions of lignin and other wood-waste products to the soil. Some emphasis has been made since then on residual or long-term effects on the soil.

Potatoes were grown in clay with three variables: (a) 800 *ml.* per plant of lignin, (b) 800 *ml.* of peat, (c) soil only. All received an equal, liberal amount of complete fertilizer. Harvest of tubers gave a moderate increase in yield for both peat and lignin over controls. The soil from these cultures was saved, remixed within each treatment, and returned to the containers. A crop of tomatoes was then grown. Lignin proved markedly beneficial to this second crop, but the low yield from peat is hard to explain.

A sandy soil was used to raise a crop of potatoes with much the same treatment as above. After harvest this soil was saved, remixed within each treatment and to the lignin- and peat-treated soils respectively was added enough of the organic matter to bring its volume up to one-third of the total when placed again in the original containers. The control was left untreated and to each was added a liberal amount of fertilizer. These were allowed to stand and compost for four months, being kept continually moist, before planting tomatoes. The most striking result was the response of the controls. Great difficulty was encountered in getting the plants to grow in this soil, and even after new plants were transplanted again, several of them failed to survive. The average yields of those that survived were lower than those treated with lignin or peat. Whether or not this effect was due to toxins, micro-organisms, or other factors is open to conjecture. At least the organic materials had some counteracting effect. A second crop of tomatoes is now being grown in these soils.

Shredded bark is another wood-waste by-products of interest. Some of this was obtained and added to soil that had been previously sterilized by steam. The soil was high in mineral nutrients. Tomatoes were planted in

this soil and in some soil without bark. Those grown in the latter soil failed to grow well, but those grown in bark plus soil thrived vigorously. Apparently, the bark absorbed, or otherwise counteracted, the effects of high nutrients which were accentuated by the steaming. Other cultures in non-sterilized soil did not show this marked initial difference.

Studies of the growth of cabbage, using two textures of sand and varying amounts of colloidal lignin, showed some benefit from lignin with sand of finer texture. They confirmed previous results with tomatoes. Water cultures with cabbage (again like tomato) showed no benefit from added lignin.

A Survey of the Soils of New Hampshire

The survey of Rockingham County was suspended early in 1942 and was resumed in September, 1946. Upon resumption of the survey, Reeshon Feuer was assigned to the work from the Bureau of Plant Industry, Soils and Agricultural Engineering, Division of Soil Survey.

Plans involve completion of the county, using aerial photographs furnished by the Soil Conservation Service. The photographs are to a scale of $1'' = 1{,}320'$. In addition to soil type, slope, and erosion, present land use (cover) will also be mapped on the aerial photographs. This change was considered necessary so that all agricultural agencies using the final map might have pertinent land information.

Rockingham County contains an area of 691 square miles; 400 square miles were mapped prior to 1946 and approximately 50 square miles between September, 1946, and June 30, 1947. Due to the more detailed nature of the mapping on aerial photographs, the rate of progress will be less than on the topographic sheets. However, the resulting map is considerably more valuable due to greater soil detail and more accurate location of soil boundaries. Maps on aerial photographs are also relatively easy to use since actual ground conditions are clearly shown.

More and more people are asking for and using soil survey information. One important use has been the locating of suitable soil types for establishing new orchards. The mapping has been used as a field training guide for training new soil scientists and students. Soil maps are being used as a basis in planning soil conservation programs on individual farms in the country.

A preliminary draft of a "*Key to the Soils of Rockingham County, New Hampshire*" has been prepared.

Reeshon Feuer

VEGETABLES

Squash Storage

Work done during the year was limited to the Butternut variety. Various treatment methods were used, but the principal one was treatment with one per cent formaldehyde and then dipping in Dowax, as contrasted to squash untreated. On December 16, 22 per cent of the treated squash and 33 per cent of those untreated had spoiled. Of the remainder, there had

been a loss of 12 per cent in weight by evaporation from the treated compared to 17 per cent loss from the untreated. On February 19, 46 per cent of the treated squash were marketable compared to 27 per cent of the untreated. Mixing of wax and formaldehyde in an attempt to give a combined treatment gave unsatisfactory results because the wax did not spread on evenly, resulting in injury from the formaldehyde in heavily coated areas. Samples of all specimens have been taken for chemical analysis.

A. F. YEAGER, T. G. PHILLIPS

Breeding Work

The principal emphasis in the tomato breeding program continues to be the development of high vitamin strains. Three bulk lots of tomato juice, canned by the Department of Agricultural and Biological Chemistry, give evidence of progress in this direction. Juice from high vitamin strains analyzed 55 milligrams; from ordinary commercial varieties, 18 milligrams; and from hybrids between commercial varieties and high vitamin strains, 35 milligrams per hundred grams of juice. These analyses were made six months after canning. Some of the high vitamin strains have acceptable commercial quality and are in the early class — at least as early as New Hampshire Victor. One strain, No. 7, was distributed this year for trial at other points in the United States. In 1946, while not of the highest analyses, it averaged in the thirties, but has other characteristics which recommend it.

The Granite State muskmelon, a new introduction, produced a splendid crop of high-quality melons in 1946. Hybrids between it and the best strains of perfect flowered muskmelons have been made. The F_1 generation was raised in the greenhouse and the F_2 generation is in the field for 1947.

Bush Buttercup was distributed to the seed trade this year using seed matured at Colebrook, New Hampshire. This is indicative of its extreme earliness. Squashes of the Blue Hubbard type but very much smaller, weighing on an average of three to four pounds, have also been developed on the semi-bush vine characteristic of Bush Buttercup. Their quality is higher than Blue Hubbard and they are much earlier, probably early enough to mature in Northern New Hampshire.

The Tiny Green bean, a New Hampshrie introduction, has created considerable interest . It is a green snap bean with a pod small enough to can whole when mature. The mature seeds are white, resulting in a canned product free from seed discoloration. This variety resulted from an original cross between a Dutch variety, Perfect Stringless, and Refugee.

A new variety of early peas, resulting from a cross between Lincoln and Radio, was named Mayflower Pea and was introduced to the trade. This is a wrinkled variety in the extreme early class, produces fair-sized, curved pods which are exceptionally well filled. In co-operation tests, under the trial name of New Hampshire Early Dwarf, it ranked at the top both in productivity and quality.

A. F. YEAGER

Varietal Tests

"Bunching" carrots were given special attention during 1946. Three successive plantings were made and the product judged as fresh material di-

rectly from the field, and later as a cooked product. Among the 16 varieties and strains judged, Morse Bunching, Imperator, Chantenay Long Type, and Strong-topped Nantes were rated at the top. As a cooked product, Imperator, Chantenay, Long-type, and Supreme Half-long rated best. Hutchinson, while low in quality in both instances, produced large handsome roots which made it a strong contender for marketability when quality was not considered a first requisite.

A. F. YEAGER

Cultural Practices

The use of cleaning fluid for spraying carrots was found to be satisfactory. Sprayed crops were raised without any cultivation. Among the various weed sprays tested in asparagus, Sinox gave the most promising results.

It has been found that in sunshine the temperature inside bean pods, cucumbers and tomatoes may be as much as 20°F warmer than in the adjoining air. Lettuce tends to remain below air temperature. Artificial infrared light produces similar results.

A. F. YEAGER, R. HOPP

STATE SERVICE

Inspection of Fertilizers and Feedingstuffs And Soil Testing

In accordance with the public statutes regulating the sale of commercial fertilizers and of concentrated commercial feedingstuffs, 63 brands of fertilizers and 591 brands of feedingstuffs were analyzed during the year 1946-47. These analyses involved individual determinations totaling 436 and 3030 respectively. Co-operation in work on analytical methods with the American Association of Feed Control Officials and with the Smalley Foundation has been continued.

Over 1950 samples of soil have been tested for residents of the state. Two soils were tested by growing plants in the greenhouse for supposed harmful constituents.

Miscellaneous Samples

Samples of feeds, fertilizers, and other materials have been analyzed for residents of the state. Seventeen samples have been examined, involving 48 determinations.

T. O. SMITH, H. A. DAVIS, G. P. PERCIVAL

Seed Inspection

The regular seed inspection work for the State Department of Agriculture was conducted as usual. During the year 2,547 samples were handled in the laboratory. Of this number 431 were collected by the State Inspectors and will be reported in Bulletin 370. A total of 2,116 samples were sent in by seed dealers in compliance with the clause in our seed law which requires that all vegetable and agricultural seed must have been tested for ger-

mination within nine months of being offered for sale and therefore, much of this testing involved seed carried over from the previous season. A few of these samples were sent in by farmers who had grown beans or corn and wished to sell them for seed.

Referee work was carried on as usual.

B. G. SANBORN

Pullorum Testing Poultry Laboratory

A total of 1,333,969 hens and turkeys in 795 flocks were tested for pullorum disease during the past season. In addition, 315,207 retests were run making a total of 1,649,176 samples tested. There were 50 reacting flocks of which 32 were breaks, *i.e.*, flocks which had tested 100 per cent without reactors during the previous season. Of the birds tested, .39 per cent (or 5,188) were found to be pullorum infected.

F. E. ALLEN, D. V. M.

Infectious Bronchitis Inoculations

During the year 1946-47, about 40 poultry flocks in the state were inoculated with infectious bronchitis virus supplied by the University of New Hampshire Poultry Laboratory. This virus is grown in disease-free susceptible birds from the University of New Hampshire poultry farm. The virus is introduced into the trachea of the bird to be inoculated by means of cotton swabs on applicator sticks. This induced attack of bronchitis confers an immunity which protects the birds in later life and particularly during its egg-producing life.

F. E. ALLEN, D. V. M.

Autopsies at Poultry Laboratory

During the fiscal year 1946-47, a total of 2,751 specimens of all kinds were submitted to the Poultry Laboratory for diagnosis. These represented 1,188 cases.

A total of 2,342 chickens, 2,137 from poultrymen and 205 from the University flock, were examined. There were 839 cases of poultry and the remainder of the specimens consisted of 210 turkeys (83 cases) and 199 miscellanoeus (71 cases) specimens.

A. C. CORBETT, D. V. M.

The National Poultry Improvement Plan

The National Poultry Improvement Plan is in operation in 47 states. Its purpose is to set up standards for and to improve the breeding of flocks for hatching eggs, baby chicks, and breeding stock. It is administered from Washington by the United States Department of Agriculture, and in this state by a board of ten active poultrymen with the co-operation of the University of New Hampshire, the Agricultural Experiment Station, and the State Department of Agriculture.

There are four progressive breeding stages under the plan: Approved, Certified, R.O.P., and R.O.M. There are now 302 flocks with 679,000 birds

operating under the Approved and Certified stages of the plan with 14 breeding flocks carrying on advanced breeding under the Record of Performance and Register of Merit stages. In these 14 R.O.P. flocks, 9,600 birds have been trapped and there have been 253 R.O.P. matings involving 3,400 birds. There were 257 check inspections and 57 R.O.P. inspections made during the year.

T. B. Charles. E. T. Bardwell

Dairy Testing

For the year ending June 30, 1947, 284 samples of milk and cream were tested for butterfat, and 89 samples were tested for bacteria. In addition 1,236 milk test bottles, 744 pipettes, and 288 cream bottles were calibrated.

Dairy Bacteriology Testing involves other services, more particularly the supplying of Babcock glassware to D.H.I.A. testers.

H. C. Moore

A total of 234 samples of milk, submitted by New Hampshire dairymen and veterinarians, were diagnosed for bovine mastitis.

L. W. Slanetz